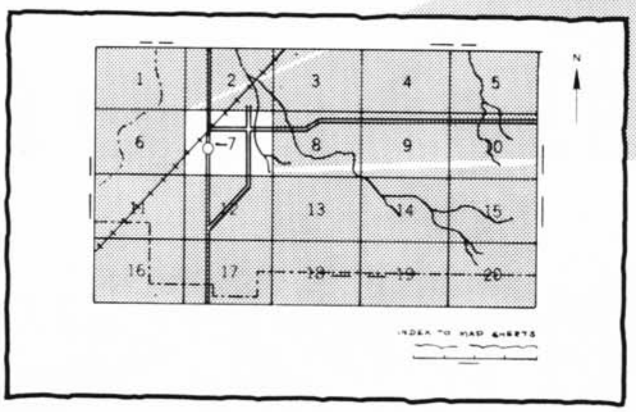
SOIL SURVEY OF

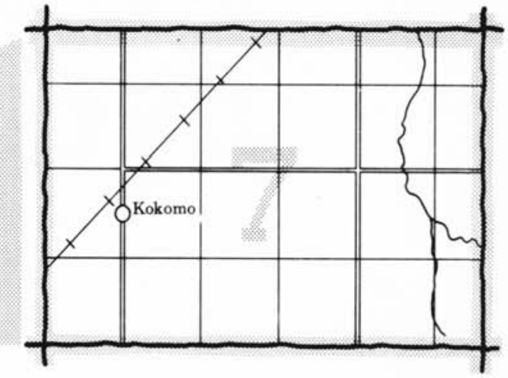
LYON COUNTY, MINNESOTA

United States Department of Agriculture
Soil Conservation Service
in cooperation with
University of Minnesota Agricultural Experiment Station

HOW TO USE

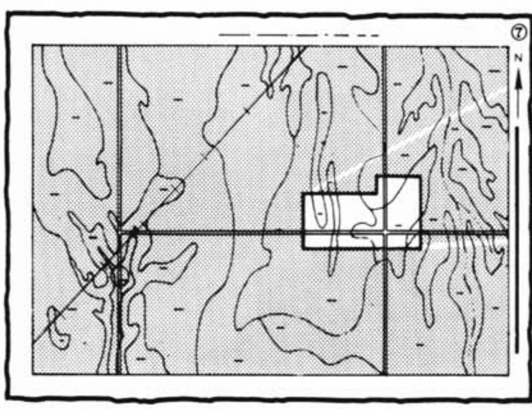
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

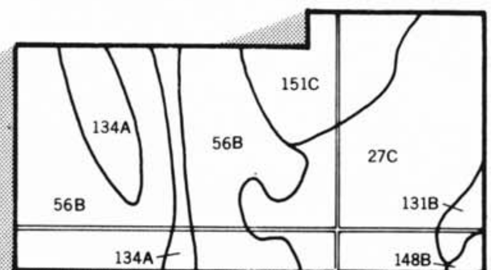




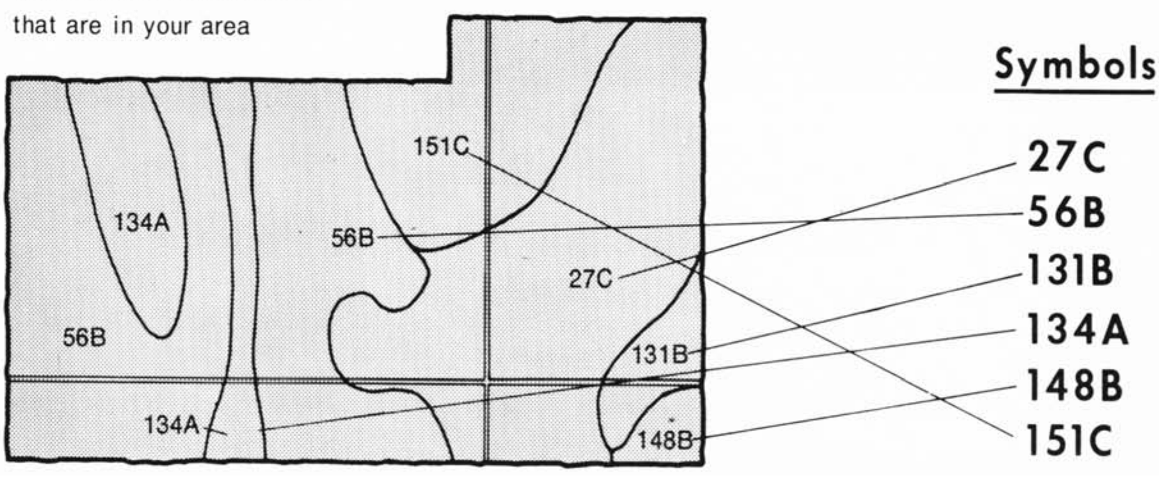
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



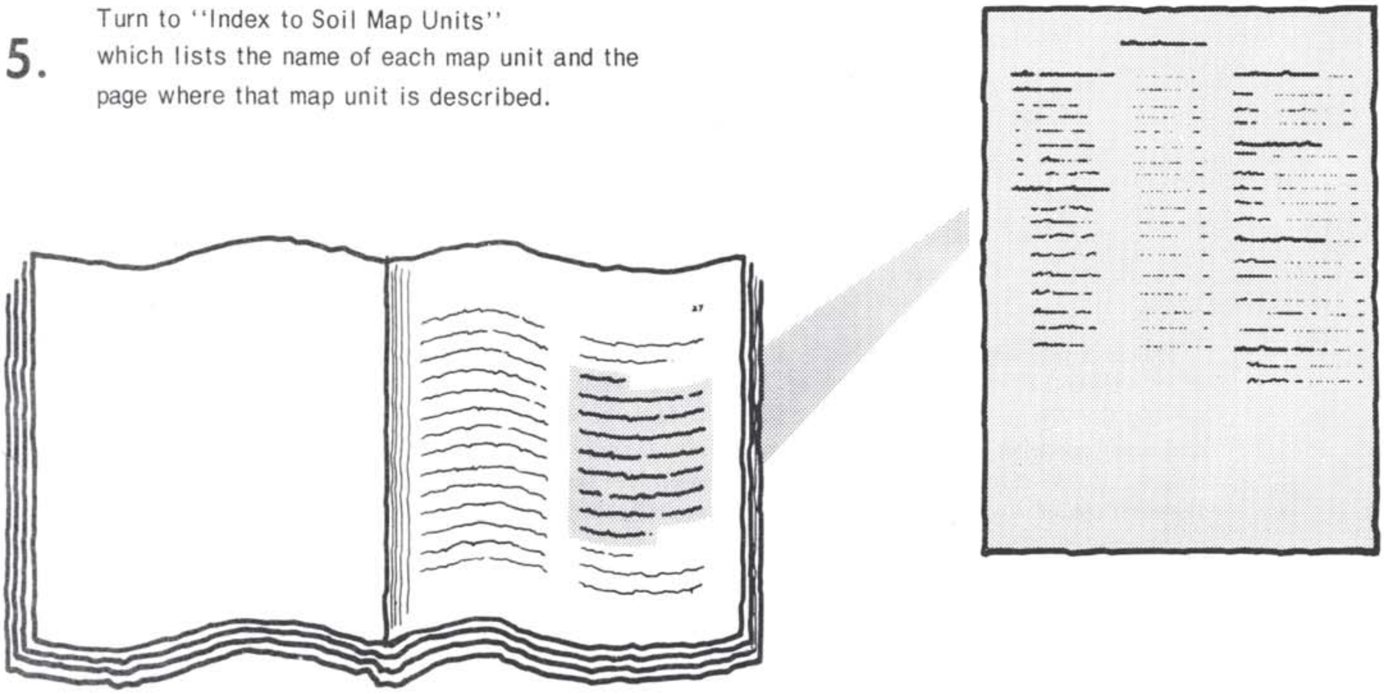


4. List the map unit symbols that are in your area

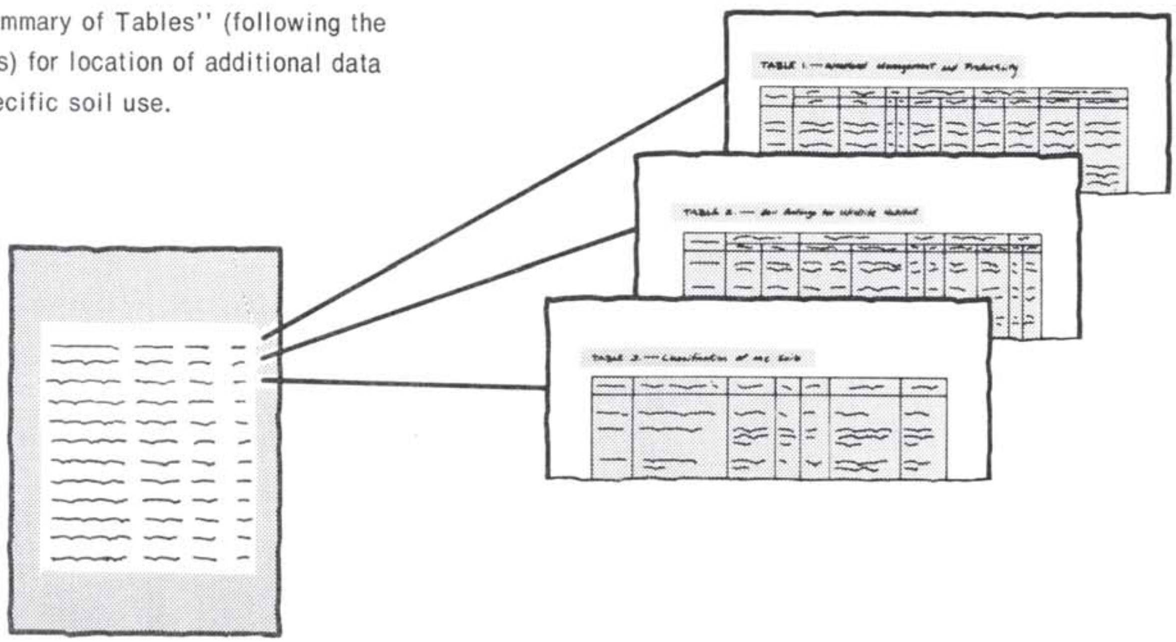


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; for specialists in wildlife management, waste disposal, or pollution control.

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1971-74. Soil names and descriptions were approved in 1975. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1975. This survey was made cooperatively by the Soil Conservation Service and the University of Minnesota Agricultural Experiment Station. It is part of the technical assistance furnished to the Lyon Soil and Water Conservation District. The Lyon County Board of Commissioners helped to fund this survey.

Soil maps in this survey may be copied without permission, but any enlargement of these maps can cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

Cover: Corn on the Ves-Canisteo map unit.

Contents

Issued December 1978

Index to map units

Summary of Tables

Summary of Tables—Continued

Foreword

The Soil Survey of Lyon County, Minnesota, contains much information useful in any land-planning program. Of prime importance are the predictions of soil behavior for selected land uses. Also highlighted are limitations or hazards to land uses that are inherent in the soil, improvements needed to overcome these limitations, and the impact that selected land uses will have on the environment.

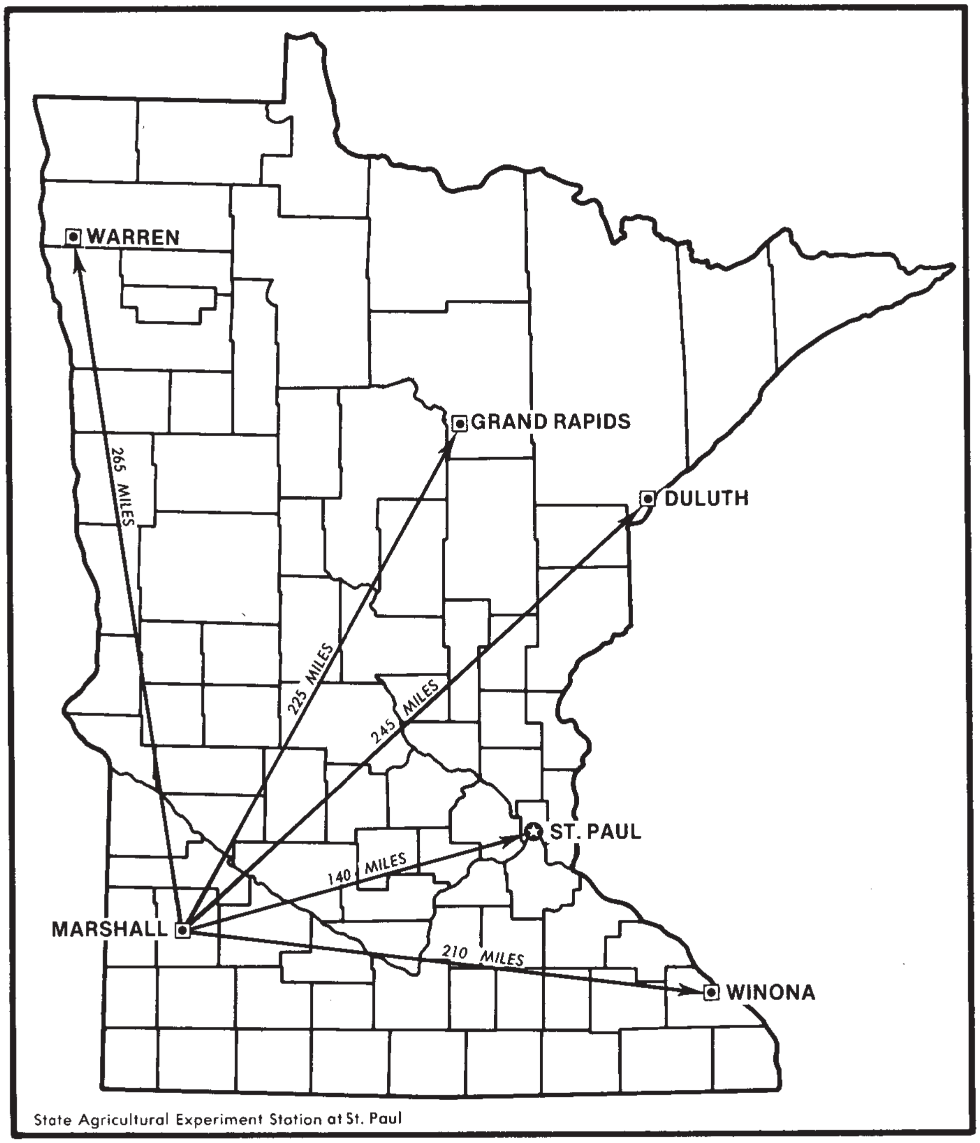
This soil survey has been prepared for many different users. Farmers, ranchers, foresters, and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, developers, builders, and homebuyers can use it to plan land use, select sites for construction, develop soil resources, or identify any special practices that may be needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the soil survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be shallow to bedrock. They may be too unstable to be used as a foundation for buildings or roads. Very clayey or wet soils are poorly suited to septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map; the location of each kind of soil is shown on detailed soil maps. Each kind of soil in the survey area is described, and much information is given about each soil for specific uses. Additional information or assistance in using this publication can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

This soil survey can be useful in the conservation, development, and productive use of soil, water, and other resources.

Harry M. Major
State Conservationist
Soil Conservation Service



Location of Lyon County in Minnesota.

SOIL SURVEY OF LYON COUNTY, MINNESOTA

United States Department of Agriculture, Soil Conservation Service, in cooperation with the University of Minnesota Agricultural Experiment Station

By Hilding L. Hokanson, Soil Conservation Service

Fieldwork by Keith A. Christensen, Raymond C. Genrich, Allan R. Gustafson, Hilding L. Hokanson, Francis D. Lorenzen, and Gary D. Nelson, Soil Conservation Service

LYON COUNTY is in the southwestern part of Minnesota (see facing page). Marshall is the county seat. The total land area is 716 square miles. The total water area is about 7 square miles. Farming is the most important enterprise. Growing corn, soybeans, small grain, and hay and cattle feeding, stockraising, and dairying produce most of the income in the county.

The soils are dark colored and nearly level to steep. They formed in glacial till or material sorted out of the till by water. The original vegetation was tall and medium prairie grasses.

The county was named after General Nathaniel Lyon, who was on frontier duty in this area during the years 1853-61. It was established by two legislative acts on March 6, 1868, and March 2, 1869. The first permanent settlements were made in 1867. The population was 268 in 1870. Soon after the first railroad was built in the county in 1872 and 1873, the population increased significantly, to 7,978 by 1885 and 14,591 by 1900. In 1970, it was 24,273.

There are 11 incorporated cities in the county—Balaton, Cottonwood, Florence, Garven, Ghent, Lynd, Marshall, Minneota, Russell, Taunton, and Tracy. The largest city is Marshall, which in 1972 had a population of 10,215.

General nature of the county

This section gives general information concerning the county. It describes climate; transportation and markets; water supply; farming; and physiography, relief, and drainage.

Climate

By BRUCE WATSON, consulting climatologist.

Lyon County is in the interior climate region of North America. Winters are cold. Summers generally are mild but are occasionally hot. Daily or weekly temperature extremes can be great in any season. Part of the county is on the Coteau des Prairies. This part has a higher altitude than the other parts (fig. 1). As a result, the mean annual soil temperature is slightly lower than that of the soils on the lowland plain.

Table 1 gives data on temperature and precipitation for the survey area, as recorded at Marshall and Lynd for the period 1888 to 1975. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring.

In winter the average temperature is 15.5 degrees F, and the average daily minimum temperature is 5.9 degrees. The lowest temperature on record, which occurred at Lynd on January 12, 1912, is minus 43 degrees. In 2 years out of 10, the lowest temperature is minus 26 degrees. In summer the average temperature is 70.4 degrees, and the average daily maximum temperature is 82 degrees. The highest recorded temperature, which occurred at Tracy on July 27, 1930, is 108 degrees.

Growing degree days, shown in table 1, are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

Of the total annual precipitation, 18.4 inches, or 75 percent, usually falls in April through September. Only 5.9 inches falls during the colder months. The heaviest 1-day rainfall during the period of record was 8.07 inches at Marshall on June 17, 1957. Thunderstorms occur on about 38 days each year, and about 9 of these days are in July.

Rainfall is usually adequate for all crops, but some part of the county nearly every year receives less than adequate moisture because midsummer moisture is mostly from thunderstorms. Crops generally are adversely affected in these areas, especially if the soils have moderate or low available water capacity. If available water capacity is high, crops are also affected when moisture reserves in the subsoil and underlying material are depleted.

Average seasonal snowfall is 38 inches. About 9.0 inches falls in January and 8.4 in March. The greatest snow depth at any one time during the period of record was 41 inches. On the average, 87 days have at least 1

inch of snow on the ground, but the number of such days varies greatly from year to year.

The minimum relative humidity, which occurs in midafternoon in May, is about 48 percent. The maximum occurs at dawn in August, when the average is about 87 percent. Relative humidity averages 83 percent in December, the highest average per month, and 66 percent in May, the lowest.

The prevailing wind is from the south, but the wind blows from the southeast about 30 percent of the time and from the northwest about 30 percent.

The average annual windspeed is 13 miles per hour. In April, the windiest month, the average is 15 miles per hour, and in August, the least windy month, it is 9 miles per hour. The strongest winds are usually from the northwest and the lightest from the northeast. Southwesterly winds are generally light in winter but often are brisk in summer. Duststorms occasionally occur in dry periods, especially in spring and fall, when plowed fields are exposed to the wind.

In summer high winds are generally brief and are more than 50 miles per hour only occasionally, during thunderstorms. Dust occasionally is blown before the rain falls during these storms. Such winds result in spotty local damage. Hail falls during the warmer part of the year, affecting small areas in an irregular pattern.

Lyon County is in the sunnier region of Minnesota. During the summer solstice, day length is 15 hours 40 minutes, and during the winter solstice, it is 8 hours 44 minutes. The percent of possible sunshine ranges from 74 in July to 47 in December. It averages 53 percent in winter, 59 percent in spring, 71 percent in summer, and 56 percent in autumn.

Transportation and markets

One railway crossing the county from northeast to southwest serves Cottonwood, Green Valley, Marshall, Lynd, Russell, and Florence. Another railway crossing from northwest to southeast serves Taunton, Minneota, Ghent, Marshall, Amiret, and Tracy. A line running west to east across the southern part of the county serves Burchard, Balaton, Garvin, and Tracy.

The major highways are either paved or blacktopped. U.S. Highway 59 crosses the county from north to south. U.S. Highway 14 crosses the southern part of the county from east to west. Minnesota Highway 23 crosses the county from northeast to southwest and Minnesota Highway 19 from east to west. Minnesota Highways 68 and 91 serve parts of the county. Gravelled or blacktopped county and township roads serve the farms.

Livestock generally are taken by truck to Sioux Falls, Sioux City, or South St. Paul. Some livestock are slaughtered in Marshall, and a number of hogs are sent to Worthington. Grain elevators are located in each of the cities. Most of the milk is marketed as whole milk and picked up by truck. A creamery operates in Russell.

Water supply

The water supply is drawn from three major sources. These sources are the sand and gravel deposits in glacial drift, the sedimentary rocks of Cretaceous age, and the Precambrian rocks.

The glacial drift is thick on the Coteau slope and the Altamont moraine (fig. 1). Most of the water is obtained from the sand and gravel deposits in this drift. The opportunities for development of a good water supply are better in the thicker sections of the drift, which have more aquifers.

On the lowland plain and the lake plain, the drift is generally too thin to be a reliable source of water. The major source is the sedimentary rocks of Cretaceous age. These rocks consist mostly of shale and fairly continuous beds of poorly cemented siltstone and sandstone. The layer of sedimentary rocks generally ranges from 125 to 455 feet in thickness. The beds of sandstone yield substantial supplies of water.

In the northeastern corner of the county, the glacial drift rests directly on Precambrian rocks. These rocks are some of the oldest on earth. They consist mostly of granite and gneiss. Water yields are from the weathered or fractured zones.

Most of the water is very hard and contains a high concentration of dissolved solids, mainly calcium, magnesium, and sulfates. Some of the sandstone aquifers, however, have softer water.

Although the water is not suitable for domestic use, many pits and ponds have been dug and built to provide water for livestock. The pits have been dug on bottom land and in other areas of poorly drained soils. They intercept runoff and are partly filled by ground water. Farm ponds are built on intermittent streams and drainageways. Some are spring fed.

Farming

Farms in Lyon County are decreasing in number and increasing in size. The number decreased from 1,447 in 1964 to 1,168 in 1972. During this period, the average size increased from 293 to 353 acres.

Corn is the most important crop. The acreage in soybeans, the second most important crop, has increased significantly since 1944. The trend has been toward a decrease in the acreage in hay and oats and an increase in the acreage in wheat. In 1965, about 150,167 acres was in corn, 51,847 acres in soybeans, 55,887 acres in small grain, and 35,082 acres in hay. In 1970, about 128,664 acres was in corn, 51,745 acres in soybeans, 46,674 acres in small grain, and 31,353 acres in hay.

Lyon County is a major feeder of beef cattle. The number of beef cattle and of hogs and pigs has remained fairly constant since 1964. The number of milk cows has generally decreased.

Physiography, relief, and drainage

The southwestern part of Lyon County is part of the Coteau des Prairies, a wedge-shaped bedrock plateau in eastern South Dakota and southwestern Minnesota (*5*). The northeastern part is a lowland plain that is a glacial ground moraine.

In the 16 miles from the southwest corner of the county to the edge of the Coteau des Prairies, the descent in elevation is more than 500 feet (fig. 1). The steep gradient is the result of the underlying Sioux quartzite. In the 14 miles from the foot of the Coteau, across the lowland plain, to the northeast corner of the county, the descent is 150 feet. The elevation is 1,719 feet above sea level in the southwest corner of the county, 1,450 feet in the southeast corner, 1,178 feet in the northwest corner, and 1,057 feet in the northeast corner. The highest point, which is near the southwest corner, is 1,740 feet above sea level.

Lyon County is mostly an undulating plain. Slopes are irregular and short, generally less than 150 feet long. The surface drainage pattern is still young, and shallow, closed depressions are common. The southwestern part is more rolling and has steeper slopes than the other parts. The lake plain is nearly level. Large nearly level areas also occur on the part of the Coteau slope that extends southwest from the lake plain.

Most of the runoff flows into the Minnesota River. Runoff drains into the Des Moines River in an area near Yankton and Balaton. This area makes up about 3 percent of the county. Tributaries of the Yellow Medicine River drain the northwestern part, or about 17 percent of the county. The Cottonwood River and its tributaries drain the southeastern part, or about 30 percent. The drainage system of the Redwood River drains the central part from the southwest to the northeast, or about 50 percent.

The southwestern part of the county is underlain by Sioux quartzite. This quartzite has been penetrated at a depth of 190 feet in Russell and 425 feet in Balaton (*6*). The rest of the county is underlain by granitic rock. This rock is at a depth of 200 feet in Cottonwood, 525 feet in Marshall, and 700 feet in Tracy. Glacial drift and sedimentary deposits of Cretaceous age overlie the bedrock. The mantle of glacial material ranges in thickness from about 50 feet in the northwestern part to more than 460 feet in the southwestern part. The sedimentary material, which was deposited in former inland seas, consists mostly of shale, sandstone, siltstone, and clay.

How this survey was made

Soil scientists made this survey to learn what kinds of soil are in the survey area, where they are, and how they can be used. The soil scientists went into the area knowing they likely would locate many soils they already knew something about and perhaps identify some they had never seen before. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material, which has been changed very little by leaching or by the action of plant roots.

The soil scientists recorded the characteristics of the profiles they studied, and they compared those profiles with others in counties nearby and in places more distant. Thus, through correlation, they classified and named the soils according to nationwide, uniform procedures.

After a guide for classifying and naming the soils was worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, roads, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called soil map units. Some map units are made up of one kind of soil, others are made up of two or more kinds of soil, and a few have little or no soil material at all. Map units are discussed in the sections "General soil map for broad land-use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of soils are taken as needed for laboratory measurements and for engineering tests. The soils are field tested, and interpretations of their behavior are modified as necessary during the course of the survey. New interpretations are added to meet local needs, mainly through field observations of different kinds of soil in different uses under different levels of management. Also, data are assembled from other sources, such as test results, records, field experience, and information available from state and local specialists. For example, data on crop yields under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it is readily available to different groups of users, among them farmers, managers of rangeland and woodland, engineers, planners, developers and builders, homebuyers, and those seeking recreation.

General soil map for broad land-use planning

The general soil map at the back of this publication shows, in color, map units that have a distinct pattern of soils and of relief and drainage. Each map unit is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for

the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map provides a broad perspective of the soils and landscapes in the survey area. It provides a basis for comparing the potential of large areas for general kinds of land use. Areas that are, for the most part, suited to certain kinds of farming or to other land uses can be identified on the map. Likewise, areas of soils having properties that are distinctly unfavorable for certain land uses can be located.

Because of its small scale, the map does not show the kind of soil at a specific site. Thus, it is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The kinds of soil in any one map unit differ from place to place in slope, depth, stoniness, drainage, or other characteristics that affect their management.

As a result of improvements in the classification of soils, particularly modifications or refinements in soil series concepts, and of the range in slope that is permitted in map units in different surveys, some of the boundaries and soil series names on the general soil map of Lyon County survey do not match those on the general soil maps of adjacent counties published at a different date.

1. Ves-Canisteo

Well drained and poorly drained, undulating and nearly level soils that formed in shaly glacial till

This map unit is on a ground moraine having short, irregular, convex knolls, most of which rise only 1 foot to 10 feet above the floor of the lowland till plain (fig. 2). Closed depressions are common. The till is a loam that contains numerous fragments of soft shale. It is the youngest till exposed in the county.

This map unit makes up about 35 percent of the county. It is about 34 percent Ves soils, 25 percent Canisteo soils, and 41 percent minor soils.

Ves soils are on convex knolls that rise 4 to 10 feet above the floor of the till plain. They are well drained. The surface layer is black and very dark gray loam about 11 inches thick. The subsoil is dark yellowish brown and brown, friable loam over light olive brown, calcareous, friable loam. It is underlain at a depth of about 36 inches by olive brown, calcareous loam.

Canisteo soils are on flats and the rims of depressions. They are poorly drained and calcareous. The surface layer is about 22 inches thick. It is mostly black clay loam. The subsoil is grayish brown, mottled, friable clay loam. It is underlain at a depth of about 31 inches by grayish brown and light olive gray, mottled loam glacial till.

Of minor extent in this map unit are Glencoe, Normania, Seaforth, and Storden soils and poorly drained soils in which the surface layer and subsoil are leached of carbonates. The Glencoe soils are in shallow, closed depressions and other low wet areas. The Normania soils are on the higher parts of drainageways and in swales on the undulating knolls. The Seaforth soils are in convex areas 1 foot to 3 feet above the floor of the till plain. The Storden soils formed on the steepest, most exposed convex parts of hillsides. The poorly drained leached soils are in drainageways that are slightly above the Canisteo soils on the landscape.

Erosion is a hazard on the Ves soils. Wetness limits the use of Canisteo soils. Canisteo soils are high in content of lime. In areas where the content is especially high, special applications of fertilizer are needed to correct the fertility imbalance. In most areas the content of organic matter and potassium is high, whereas that of phosphorus is low. Available water capacity is high. Maintaining tilth and fertility and controlling water erosion are other management concerns.

Corn, soybeans, small grain, and hay grow well on these soils. Nearly all of the acreage is used for cultivated crops. A few wet areas where more drainage is needed before crops can be successfully grown are used for pasture. The main enterprises are growing cash crops, raising hogs, and feeding beef cattle. The soils have a good potential for all of the cultivated crops grown in the county.

2. Lamoure-La Prairie

Poorly drained and moderately well drained, nearly level soils that formed in alluvial material

This map unit is on the widest part of the nearly level flood plains and in overflow channels. It makes up about 5 percent of the county. It is about 50 percent Lamoure soils, 21 percent La Prairie soils, and 29 percent minor soils.

Lamoure soils are on bottom land, typically on the lower levels of the flood plain. They formed in silty material deposited by floodwater. They are poorly drained and calcareous. The surface layer is silty clay loam about 25 inches thick. It is black in the upper part and very dark gray in the lower part. The subsoil is very dark gray, mottled, friable silty clay loam. It is underlain at a depth of about 38 inches by mostly dark grayish brown, mottled silty clay loam alluvium.

La Prairie soils are on the slightly higher levels of the flood plain. They are deep and moderately well drained. The surface layer is black loam in the upper part and very dark gray, calcareous loam in the lower part. It is about 30 inches thick. The subsoil is dark grayish brown and very dark gray, calcareous, friable loam about 10 inches thick. It is underlain at a depth of about 40 inches by calcareous, very dark grayish brown silt loam and fine sand.

Minor in this map unit are Marysland, Colvin, Rauville, Canisteo, Seaforth, Fordville, Sverdrup, and Arvilla soils. The Rauville soils are in very low areas, such as depressions and old stream meanders. The poorly drained Colvin and Marysland soils are in the overflow channels that lie between the streams, mainly on the lake plain. The Colvin

soils are silty, and the Marysland soils are underlain by sand and gravel. The poorly drained Canisteo soils and the moderately well drained Seaforth soils are in the overflow channel between the Yellow Medicine River and Three Mile Creek where glacial till is exposed. They generally are stony. The well drained Fordville soils and the somewhat excessively drained Sverdrup and Arvilla soils are in small areas on sandy and gravelly terraces.

Lamoure soils are wet and occasionally flooded. La Prairie soils are productive and are occasionally flooded. Some areas of both soils are frequently flooded. Flooding normally occurs in spring. About once every 10 years, it occurs during the growing season and crops are damaged. Available water capacity is high. The content of organic matter also is high. The content of potassium is medium or high, and that of phosphorus is low. Most areas can benefit from special applications of fertilizer because the lime content in the surface layer is generally high.

Corn and soybeans are grown on most of the cropland. Small grain is grown on a small acreage. About half of the areas are cultivated. Some areas that are frequently flooded or are too wet for cropland are used for pasture or wildlife habitat. On most of the farms, cash grain crops are grown and livestock is raised. The soils have good potential for cultivated crops, especially if artificial drainage and flood control are feasible.

3. Colvin-Bearden

Poorly drained and somewhat poorly drained, nearly level soils that formed in lacustrine and alluvial sediments

This map unit consists of a narrow ice-marginal glacial lake that extends northwest from Lake Marshall through Lyon, Lincoln, Yellow Medicine, and Lac qui Parle Counties to the South Dakota border. The lake formed between the higher land to the southwest, called the Coteau slope, and glacial ice to the north. The lacustrine deposits on the lake plain have been covered with alluvium deposited by the rivers, creeks, and many minor drainageways that flow from the Coteau slope. Many areas of buried soils occur in the lake plain as a result of these deposits of sediment.

This map unit makes up about 4 percent of the county. It is about 50 percent Colvin soils, 25 percent Bearden soils, and 25 percent minor soils.

Colvin soils are on the flat and slightly concave parts of the landscape. They are poorly drained and calcareous. The surface layer is black and very dark gray clay loam and silt loam about 14 inches thick. The subsoil is dark gray and very dark gray, friable loam and clay loam about 19 inches thick. Below the subsoil is a buried surface layer that was the original surface layer of a glacial lake plain. It is black silty clay. The underlying material is grayish, mottled silty clay loam.

Bearden soils are on slightly convex ridges that rise 1 foot to 3 feet above the Colvin soils. They are nearly level, somewhat poorly drained, and calcareous. The surface layer is black silty clay loam about 14 inches thick. The subsoil is about 23 inches of very dark grayish brown, friable silt loam and dark gray, friable silty clay loam. A buried surface layer of a former lakebed is at a depth of 37 inches. It is black clay loam about 7 inches thick. Below this is very dark gray and grayish brown loam and clay loam.

Minor in this map unit are Malachy, Marysland, and Oldham soils. The Malachy soils formed in loamy lake-laid sediments and are underlain by sand and gravel. They are moderately well drained. The poorly drained Marysland soils formed in similar sediments. The Oldham soils formed in silty and clayey lake-laid sediments in depressions and wet swales. They are poorly drained and nearly level. The Fordville, Arvilla, and Sverdrup soils are in small areas on sandy and gravelly terraces. The moderately well drained Seaforth soils formed on a few islands in the lake basin where glacial till is exposed.

Wetness and flooding are the major concerns of management. Open ditches can drain the surface water, help to confine the floodwater, and serve as outlets for tile drains. Available water capacity is high. The content of potassium is medium or high, the content of phosphorus is low, and the content of organic matter is high. In most areas special applications of fertilizer are needed because the lime content in the surface layer is extremely high.

Corn and soybeans are the major crops. Small grain and alfalfa are grown on a small acreage. Most areas are cultivated, but areas that are frequently flooded or are too wet for cropland are used for pasture and wildlife habitat. Cash grain crops are grown on most of the farms. A few farmers raise hogs or feed beef cattle. The soils have good potential for cultivated crops, especially corn and soybeans.

4. Forman-Aastad

Well drained and moderately well drained, undulating and nearly level soils that formed in glacial till

This map unit is on the Coteau slope, the first slope of the Coteau des Prairies. It slopes southwest to northeast about 50 feet per mile and also slopes very gradually from northwest to southeast. Deep narrow drainageways that run in a northeasterly direction dissect the Coteau slope every half mile to every mile. These drainageways have sloping to very steep sides. The soils are mainly undulating and nearly level. The glacial till typically is clay loam. A few sandy or gravelly areas occur along the edges of the unit.

This map unit makes up about 21 percent of the county. It is about 41 percent Forman soils, 16 percent Aastad soils, and 43 percent minor soils (fig. 3).

Forman soils are on the convex parts of the Coteau slope and are adjacent to the steeper side slopes along drainageways. They are undulating and well drained. The

surface layer is mostly black and very dark gray clay loam about 11 inches thick. The subsoil is dark brown, firm clay loam over light olive brown, friable, calcareous clay loam. It is underlain at a depth of about 25 inches by grayish brown, calcareous clay loam.

Aastad soils are nearly level and moderately well drained. They formed on the plane and slightly concave parts of the Coteau slope. The surface layer is black clay loam about 12 inches thick. The subsoil is dark olive brown, firm clay loam over light olive brown, calcareous, friable clay loam. It is underlain at a depth of 28 inches by grayish brown, mottled, calcareous clay loam.

Minor in this map unit are Flom, Buse, Darnen, Hamerly, Quam, Vallers, Lamoure, and La Prairie soils. The nearly level, poorly drained Flom soils are in shallow drainageways and on flats. The sloping and moderately steep Buse soils are near the Forman soils. The steep and very steep Buse soils are along deep drainageways and along the streams that cross the unit. The Darnen soils are on foot slopes and at the head of drainageways. The Lamoure and La Prairie soils are in the deep drainageways and along the streams. The Quam soils are in the closed depressions. The calcareous, poorly drained Vallers soils are on the rims of closed depressions. The calcareous, somewhat poorly drained Hamerly soils are on low islands within areas of Flom and Vallers soils.

Water erosion is not a major hazard unless the steeper side slopes along the deep drainageways are cultivated. Soil blowing is sometimes a problem, especially in spring. Wetness is the major limitation to the use of the minor Flom soils. Other concerns of management are improving drainage and maintaining tilth and fertility. Available water capacity is high. The content of organic matter and potassium is high, and that of phosphorus is low. The soils are not deficient in lime.

Corn, soybeans, small grain, and hay grow well on the nearly level and undulating soils. Generally, the acreage in row crops is larger in the southeastern part of the unit than in the northwestern part, and the acreage in small grain is smaller in the southeastern part than in the northwestern part. Nearly all areas are used for cultivated crops, but the steeper drainageways and the undrained wet areas are used for permanent pasture and wildlife habitat. The main enterprises are growing cash crops and feeding beef cattle. The soils have good potential for all of the cultivated crops grown in the county.

5. Arvilla-Barnes-Buse

Somewhat excessively drained and well drained, nearly level to moderately steep soils that formed in glacial outwash, drift, and till

This map unit is in melt water channels, on outwash plains, and on remnants of dead-ice moraines. It is mainly undulating and rolling but also is nearly level, moderately steep, and steep in places. More than a third of these soils formed in or are underlain by sandy or gravelly glacial drift. The rest formed in glacial till or alluvium.

This map unit makes up about 4 percent of the county. It is about 25 percent Arvilla soils, 15 percent Barnes soils, 13 percent Buse soils, and 47 percent minor soils (fig. 4).

Arvilla soils are somewhat excessively drained. They are dominantly nearly level to rolling, but near the Barnes and Buse soils they are undulating to moderately steep. The surface layer is black sandy loam about 9 inches thick. The subsoil is about 10 inches thick. It is very dark grayish brown, friable sandy loam over dark brown, very friable coarse sandy loam. The underlying material is dark yellowish brown and brown, calcareous gravelly loamy coarse sand.

Barnes soils are well drained. They are mainly undulating but are steeper near the Buse soils. The surface layer is loam about 11 inches thick. It is black in the upper part and dark brown and dark yellowish brown in the lower part. The subsoil is yellowish brown, friable loam over light olive brown, calcareous, friable loam. It is underlain at a depth of about 24 inches by olive brown, light olive brown, and gray, calcareous loam.

Buse soils are well drained and are mainly rolling and moderately steep. They are closely intermingled with the Barnes soils. On the steeper slopes, they occur alone. The surface layer is very dark gray, calcareous loam about 7 inches thick. Below this is a transitional layer of very dark gray and brown loam about 7 inches thick. It has many worm casts and root channels. The underlying material is dark yellowish brown, dark grayish brown, and light olive brown, calcareous loam.

Minor in this map unit are Fordville, Sverdrup, Lamoure, La Prairie, and Vallers soils. The Fordville soils are underlain by sand and gravel, and the Sverdrup soils formed in sandy material. The Lamoure and La Prairie soils are on the narrow bottom land along the rivers and creeks. The calcareous, poorly drained loamy Vallers soils are on rims of depressions and on flats.

A low available water capacity is the major limitation of the Arvilla soils. Erosion is the major hazard of the Barnes and Buse soils.

Small grain, corn, and hay are the main crops. Although most of the acreage is cultivated, some of the acreage on the steeper slopes, the frequently flooded bottom land, and the dead-ice moraine and in the gravelly areas is used for range and wildlife habitat. The main enterprises are growing cash crops, raising hogs and beef cattle, and feeding beef cattle. These soils provide the best sources of sand and gravel in the county. They have fair or good potential for cultivated crops and good potential for hay and range.

6. Barnes-Flom-Buse

Well drained and poorly drained, nearly level to moderately steep soils that formed in glacial till

This map unit is on irregular, complex slopes on dead-ice moraines and on smooth, simple slopes on ice-walled

lake plains. It has the highest elevations in the county. It is mainly nearly level to rolling but also is moderately steep.

This map unit makes up about 23 percent of the county. It is about 45 percent Barnes soils, 14 percent Flom soils, 11 percent Buse soils, and 30 percent minor soils (fig. 5).

Barnes soils are well drained. They are mainly undulating but are steeper near the Buse soils. The surface layer is loam about 11 inches thick. It is black in the upper part and dark brown and dark yellowish brown in the lower part. The subsoil is yellowish brown, friable loam over light olive brown, friable, calcareous loam. It is underlain at a depth of about 24 inches by olive brown, light olive brown, and gray, calcareous loam.

Flom soils are nearly level and poorly drained. They are in shallow drainageways and on wet flats. The surface layer is black and very dark grayish brown clay loam about 20 inches thick. The subsoil is dark gray, mottled, firm clay loam. It is underlain at a depth of about 39 inches by olive gray, mottled, calcareous clay loam.

Buse soils are mainly rolling and moderately steep. They are closely intermingled with the Barnes soils. In the steeper areas they occur alone. The surface layer is very dark gray, calcareous loam about 7 inches thick. Below this is a transitional layer of very dark gray and brown loam about 7 inches thick. It has many worm casts and root channels. The underlying material is dark yellowish brown, dark grayish brown, and light olive brown, calcareous loam.

Minor in this map unit are Quam, Vallers, Hamerly, and Svea soils, which formed in glacial till, and Sinai, Fulda, and Poinsett soils, which formed in lacustrine sediments on ice-walled lake plains. The Quam soils are in closed depressions. The calcareous, poorly drained Vallers soils are on the rims of closed depressions. The calcareous, somewhat poorly drained Hamerly soils are on low islands within areas of Flom and Vallers soils. The moderately well drained Svea soils are on the concave parts of slopes and drainageways. The nearly level Fulda and Sinai soils formed in silty clay lacustrine sediments. The gently sloping Poinsett soils formed in silty clay loam lacustrine sediments.

Erosion on the Barnes and Buse soils and wetness in the Flom soils are the major concerns of management. In many areas of the Barnes and Buse soils, slopes are too irregular or complex for contour farming. Minimum tillage and grasses and legumes help to control erosion. Tile and surface ditches can drain the Flom soils and the other soils that are limited by wetness.

Corn, small grain, and hay are the principal crops. Most of the acreage is cultivated, but the steeper hillsides and the undrained wet areas are used for range and wildlife habitat. The main enterprises are growing cash crops, feeding beef cattle, and raising hogs and beef cattle. Most of the soils have good potential for cultivated crops. Generally, the soils that are poorly suited to cultivated crops have good or fair potential for range.

7. Everly-Letri-Wilmonton

Well drained, poorly drained, and moderately well drained, nearly level to rolling soils that formed in glacial till

This map unit is mainly nearly level and undulating, but in a few places it is rolling to very steep. The steeper areas are mainly along the deep drainageways that dissect the unit about every half mile in a northeasterly direction. The southern part of the unit is mostly undulating and has some lakes. Nearly all areas have been drained. A few areas of sand and gravel are in the northeast corner, where the unit descends to the lake plain.

This map unit makes up about 8 percent of the county. It is about 47 percent Everly soils, 22 percent Letri soils, 13 percent Wilmonton soils, and 18 percent minor soils.

Everly soils are well drained and are mainly undulating and rolling. The surface layer is very dark gray clay loam about 10 inches thick. The subsoil is brown and dark yellowish brown, firm to friable clay loam about 16 inches thick. It is underlain at a depth of 26 inches by yellowish brown, calcareous loam.

The poorly drained Letri soils are on flats and in shallow drainageways near the better drained Wilmonton and Everly soils. The surface layer is clay loam about 20 inches thick. It is black in the upper part and very dark gray in the lower part. The subsoil is about 15 inches thick. It is dark gray, mottled, firm clay loam over olive gray, mottled, friable to firm clay loam. It is underlain at a depth of 35 inches by olive gray, mottled, calcareous loam glacial till.

The moderately well drained Wilmonton soils are in nearly level areas and on the lower parts of undulating areas. The surface layer is black clay loam about 18 inches thick. The subsoil is dark grayish brown, mottled, firm clay loam. It is underlain at a depth of about 31 inches by dark grayish brown and light olive brown, mottled, calcareous clay loam glacial till.

Minor in this map unit are Storden, Buse, Lamoure, La Prairie, and Glencoe soils. The well drained, moderately steep Storden soils are in close association with the Everly soils. The well drained, steep and very steep Buse soils are along the deep drainageways that dissect the unit. The Lamoure and La Prairie soils are along the Cottonwood River and in some of the deep drainageways. The Glencoe soils are in shallow, closed depressions.

Wetness in the Letri soils and the hazard of erosion on the Everly soils are the major concerns of management. The Wilmonton soils have no serious limitations. The Letri soils benefit from supplemental tile drainage. The Everly soils benefit from minimum tillage and from contour erosion-control measures if the slopes are suitable. The steeper side slopes along the drainageways are highly erodible, but most are grassed over. Soil blowing is sometimes a problem, especially in spring. Most of the acreage is suitable for intensive farming. Good farming

methods, drainage, and control of erosion are needed. Available water capacity is high. The content of organic matter and of potassium is high, and that of phosphorus is low. The content of lime is ample.

Most of the acreage is used for corn and soybeans. Small grain and alfalfa are also grown. The steep drainageways and undrained wet areas are used for pasture and wildlife habitat. The main enterprises are growing corn and soybeans for cash and feeding beef cattle. The soils have good potential for all of the cultivated crops grown in the county.

Soil maps for detailed planning

The map units shown on the detailed soil maps at the back of this publication represent the kinds of soil in the survey area. They are described in this section. The descriptions together with the soil maps can be useful in determining the potential of a soil and in managing it for food and fiber production; in planning land use and developing soil resources; and in enhancing, protecting, and preserving the environment. More information for each map unit, or soil, is given in the section "Use and management of the soils."

Preceding the name of each map unit is the symbol that identifies the soil on the detailed soil maps. Each soil description includes general facts about the soil and a brief description of the soil profile. In each description, the principal hazards and limitations are indicated, and the management concerns and practices needed are discussed.

The map units on the detailed soil maps represent an area on the landscape made up mostly of the soil or soils for which the unit is named. Most of the delineations shown on the detailed soil map are phases of soil series.

Soils that have a profile that is almost alike make up a *soil series*. Except for allowable differences in texture of the surface layer or of the underlying substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement in the profile. A soil series commonly is named for a town or geographic feature near the place where a soil of that series was first observed and mapped. Barnes and Sioux, for example, are the names of two soil series.

Soils of one series can differ in texture of the surface layer or in the underlying substratum and in slope, erosion, stoniness, salinity, wetness, or other characteristics that affect their use. On the basis of such differences, a soil series is divided into phases. The name of a *soil phase* commonly indicates a feature that affects use or management. For example, Arvilla sandy loam, 0 to 2 percent slopes, is one of several phases within the Arvilla series.

Most map units include small, scattered areas of soils other than those that appear in the name of the map unit. Some of these soils have properties that differ substantially from those of the dominant soil or soils and thus could significantly affect use and management of the map unit. These soils are described in the description of each map unit. Some of the more unusual or strongly contrasting soils that are included are identified by a special symbol on the soil map.

Most mapped areas include places that have little or no soil material and support little or no vegetation. Such places are called *miscellaneous areas*; they are delineated on the soil map and given descriptive names. Pits, gravel, is an example. Some of these areas are too small to be delineated and are identified by a special symbol on the soil map.

The acreage and proportionate extent of each map unit are given in table 3, and additional information on properties, limitations, capabilities, and potentials for many soil uses is given for each kind of soil in other tables in this survey. (See "Summary of tables.") Many of the terms used in describing soils are defined in the Glossary.

6—Aastad clay loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on uplands. A few stones and boulders are on the surface and in the soil. Slopes are plane or slightly concave. Individual areas range from 3 to more than 200 acres in size.

Typically, the surface layer is black clay loam about 12 inches thick. The subsoil is about 16 inches thick. It is dark olive brown, firm clay loam in the upper part and light olive brown, calcareous, friable clay loam in the lower part. The underlying material to a depth of about 68 inches is grayish brown, mottled, calcareous clay loam glacial till. In some eroded spots the brownish subsoil is exposed.

Included with this soil in mapping are some small areas of the poorly drained Flom soils in narrow drainageways, nearly level areas of the well drained Forman soils above deep drainageways, areas of Hamerly soils on slightly convex low knolls, and areas of the very poorly drained Quam soils in shallow depressions. These soils make up 5 to 20 percent of the unit.

Permeability is moderately slow, and available water capacity is high. Reaction is neutral in the surface layer. The content of organic matter is high, the content of phosphorus is low, and the content of potassium is medium or high. The seasonal high water table is at a depth of 3 to 6 feet.

Most areas are cropped. This soil has good potential for cultivated crops, hay crops, and windbreaks. It has fair potential for most engineering uses.

This soil is well suited to all of the crops commonly grown in the county. It has few limitations that restrict its use, and it can be cropped intensively. This moderately well drained soil does not dry out so quickly in the spring as the nearby well drained Forman soil, and it cannot be worked so early. Leaving crop residue on the surface of fall-plowed fields helps to control soil blowing. An occasional green manure or sod crop helps to maintain good structure and tilth.

This soil has few characteristics detrimental to the growth and survival of the trees and shrubs commonly needed in windbreaks. Weeds and grasses can be con-

trolled in newly established windbreaks by shallow cultivation or approved herbicides. Seedlings are difficult to establish, and some die during the first year because of the content of clay. Seedling mortality can be partly overcome by not working the soil or planting seedlings when the soil is too wet. If the site for a windbreak is in sod, plowing and disking during the summer or fall before planting increase the moisture supply and kill unwanted vegetation.

The moderately slow permeability is a limitation if this soil is used as a septic tank absorption field, but this limitation can be overcome by increasing the size of the absorption area. The seasonal high water table, the shrink-swell potential, and the susceptibility to frost action moderately limit most engineering uses. Installing drainage tile around the footings is the easiest method to control the water table in areas where dwellings with basements are built. The hazard of frost heave and the shrinking and swelling can be overcome on sites for local roads and streets and unheated buildings without basements by providing good surface drainage and by providing a cover of more suitable material in the base. Special design or precautions are needed if small areas of Flom and Quam soils are on the construction site. These soils have a shallower seasonal high water table than the Aastad soil. Capability class I.

33B—Barnes loam, 1 to 4 percent slopes. This gently undulating, well drained soil is on glaciated uplands. Slopes are complex and convex and 100 to 175 feet long. A few stones and pebbles are on the surface and in the soil. Individual areas range from 3 to 80 acres in size.

Typically, the surface layer is loam about 11 inches thick (fig. 6). The upper part is black, and the lower part is dark brown and dark yellowish brown. The lower part has many very dark brown worm casts. The subsoil is friable loam about 13 inches thick. It is yellowish brown in the upper part and light olive brown and calcareous in the lower part. The underlying material to a depth of about 60 inches is olive brown, light olive brown, and gray, calcareous loam glacial till. In a few eroded spots the brownish subsoil is exposed.

Included with this soil in mapping are small areas of the more sloping and eroded Barnes soils and Svea, Flom, and Quam soils. The moderately well drained Svea soils are on foot slopes and other slightly concave areas; the poorly drained Flom soils are in shallow drainageways; and the very poorly drained Quam soils are in closed depressions. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate, surface runoff is medium, and available water capacity is high. The surface layer is mildly alkaline or neutral. The content of organic matter is naturally high, the content of phosphorus is very low, and the content of potassium is medium. The seasonal high water table is at a depth of more than 6 feet.

Most areas are cropped. If it occurs among steep and droughty soils, this soil is commonly used for grazing. It has good potential for cultivated crops, range, and windbreaks and for most engineering uses.

This soil is suited to all of the crops commonly grown in the county. The hazard of erosion is slight. Stones are sometimes pushed to the surface by tillage and by frost action. Tillage is easier if the stones are removed periodically. The short and complex slopes are generally not well suited to terracing and contour farming. Minimum tillage practices, such as chisel plowing, help to control erosion. Leaving crop residue on the surface and keeping the surface rough reduce the risk of soil blowing on fall plowed fields during winter and spring. An occasional green manure or sod crop helps to maintain good structure and tilth. Grassed waterways are needed in areas where water collects on and crosses this soil.

This soil is well suited to the trees and shrubs needed in windbreaks. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides. Soil blowing and water erosion can be controlled by maintaining a mulch of crop residue on the surface. If the site for a windbreak is in sod, plowing and disking during the summer or fall before planting increase the moisture supply and kill unwanted vegetation.

Septic tank absorption fields are commonly used on this soil. The moderate permeability, a limitation, can be overcome by increasing the size of the absorption area. Local roads are moderately susceptible to frost action. The frost action can be easily controlled by removing surface water along the roadbed and by using less susceptible material in the base. If the underlying material is used as roadfill, it is suitable in the subgrade, but stronger material that is less susceptible to frost action is needed in the base. This soil is a good source of topsoil. In most of the small areas of included soils, a seasonal high water table within a depth of 6 feet moderately or severely limits most engineering uses. Capability subclass IIe; Silty range site.

33B2—Barnes loam, 3 to 6 percent slopes, eroded. This undulating, well drained soil is on ridgetops and the upper parts of hills and knolls. Slopes are complex and convex and are 100 to 150 feet long. A few stones and pebbles are on the surface and in the soil. Individual areas range from 3 to 50 acres in size.

Typically, the surface layer is very dark brown loam about 7 inches thick. The subsoil is friable loam about 13 inches thick. The upper part is yellowish brown and contains numerous very dark brown worm casts, and the lower part is light olive brown and calcareous. The underlying material to a depth of about 60 inches is olive brown, light olive brown, and gray, calcareous loam glacial till. In a few areas the surface layer is clay loam or sandy clay loam. In places the subsoil is thicker and is deeper to lime. It is exposed in spots on hillsides.

Included with this soil in mapping are some sandy, gravelly, or stony spots. Also included are small areas of Buse and Flom soils, which make up 5 to 20 percent of the unit. The well drained Buse soils, which are on the most exposed, steepest side slopes, have a thin, light colored, calcareous surface layer. The poorly drained Flom soils are in shallow drainageways.

Permeability is moderate, surface runoff is medium, and available water capacity is high. Reaction is neutral in the surface layer. The content of organic matter is moderate or high, the content of phosphorus is very low, and the content of potassium is medium. The seasonal high water table is at a depth of more than 6 feet.

Most areas are cropped. This soil has good potential for cultivated crops, range, and windbreaks and for most engineering uses.

This soil is suited to all of the crops commonly grown in the county. The hazard of erosion is moderate. Stones are sometimes pushed to the surface by tillage and by frost action. Tillage is easier if the stones are removed periodically. If the slopes are suitable, contouring is effective in controlling erosion and in holding water on the soil. Minimum tillage practices, such as chisel plowing, also help to control erosion, particularly in areas not suited to contouring. Leaving crop residue on the surface and keeping the surface rough reduce the risk of soil blowing on fall-plowed fields during winter and spring. An occasional green manure or sod crop helps to maintain good structure and tilth. Grassed waterways are needed in areas where water collects on and crosses the soil.

This soil is suited to the trees and shrubs needed in windbreaks. Water erosion and soil blowing can be controlled by maintaining a mulch of crop residue. In places windbreaks can be planted on the contour. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides. If the site for a windbreak is in sod, plowing and disking during the summer or fall before planting increase the moisture supply and kill unwanted vegetation.

This soil is commonly used for onsite sanitary waste disposal and as a septic tank absorption field. The moderate permeability, a limitation, can be overcome by increasing the size of the absorption area. The soil generally is suited as a site for dwellings. The floor in unheated buildings without basements, however, is susceptible to frost heave.

Local roads are moderately susceptible to frost action. The frost action can be easily controlled by removing surface water along the roadbed and by using less susceptible base material. If the underlying material is used as roadfill, it is suitable in the subgrade, but stronger material that is less susceptible to frost action is needed in the base. Special design or precautions are needed if the small areas of included Flom soils are on the construction site because the seasonal high water table is closer to the surface. Capability subclass IIe; Silty range site.

36—Flom clay loam. This nearly level, poorly drained soil is in low areas in drainageways and around depressions in the glaciated uplands. Some areas are flooded when the snow melts in the spring or after heavy rains. Some of the drainageways are gently sloping. Individual areas are irregular in shape and range from 3 to several hundred acres in size.

Typically, the surface layer is clay loam about 20 inches thick. The upper part is black, and the lower part is very dark grayish brown and mottled. The subsoil is dark gray, mottled, firm clay loam about 19 inches thick. The underlying material to a depth of about 60 inches is olive gray, mottled, calcareous clay loam glacial till. The till is loam in some areas. In places the glacial till in the upper part of the profile has been sorted and redeposited by water. The reworked material is less stony and more silty than the underlying glacial till. In many drainageways a surface layer more than 24 inches thick has accumulated.

Included with this soil in mapping are small areas of Vallers, Fulda, and Quam soils, which make up 5 to 15 percent of the unit. The poorly drained, calcareous Vallers soils are on the rims of depressions; the poorly drained clayey Fulda soils are in the same position on the landscape as Flom soils; and the very poorly drained Quam soils are in shallow, closed depressions.

Permeability is moderately slow, available water capacity is high, and surface runoff is slow. The surface layer is neutral in most places but is slightly acid or mildly alkaline in some places. The content of organic matter is high, the content of phosphorus is low, and the content of potassium is medium or high. The seasonal high water table is at a depth of 1 foot to 3 feet in all areas but those where drainage tiles have been installed.

Most areas are cropped. A few are used for grazing or wild hay. This soil has good potential for cultivated crops. It has fair potential for windbreaks and poor potential for most engineering uses.

Drainage generally is needed before this soil can be farmed intensively. If drainage is provided, all of the crops commonly grown in the county, especially corn, are suitable. The main limitation is wetness. The soil dries out and warms up slowly in spring. Tile is needed to provide subsurface drainage. Unless adequately drained, the soil sometimes must be worked when too wet, and severe compaction and clodding of the surface layer are likely to occur. Fall plowing permits rapid preparation of a seedbed in spring. Large open areas are subject to soil blowing if tilth deteriorates because an inadequate amount of crop residue is returned to the soil. Grassed waterways are needed in areas where water flows across the soil (fig. 7).

Unless surface water is a problem, this soil has fair potential for the trees and shrubs needed in windbreaks. If adequate subsurface drainage is provided, more species of trees and shrubs can be grown successfully. Site preparation should be completed during the fall before planting because in many years clods form if the soil is worked when it is too wet early in spring. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides.

This soil has poor potential for building site development and most other engineering uses because it is wet. On sites for dwellings and small buildings without basements, artificial drainage and control of surface water are needed. Foundations and footings should be designed to

prevent the structural damage caused by frost action and by shrinking and swelling.

Standard septic tank absorption fields are not suitable because of the seasonal high water table and the moderately slow permeability. In places mound-type absorption fields are suitable. If local roads are to function properly, a cover of suitable base material is needed. In addition, surface water can be removed by adequately designed road ditches. Capability subclass IIw; Subirrigated range site.

51—La Prairie loam. This nearly level, moderately well drained soil is on bottom land that is subject to occasional overflow. It is on the highest parts of the bottom land, mostly adjacent to the stream. Individual areas range from 10 to more than 200 acres in size.

Typically, the surface layer is about 30 inches thick. It is black loam in the upper part and very dark gray, calcareous loam in the lower part. The subsoil is dark grayish brown and very dark gray, calcareous, friable loam about 10 inches thick. The underlying material to a depth of about 60 inches is very dark grayish brown, mottled, calcareous, stratified silt loam and fine sand.

Included with this soil in mapping is a small acreage on the high parts of bottom land that are not subject to overflow and a few areas where beds of sand and gravel are at a depth of more than 40 inches. Also included are small deposits of sand and gravel in areas of Sverdrup, Arvilla, and Sioux soils. These deposits make up 1 to 5 percent of the unit.

Permeability is moderate, available water capacity is high, and surface runoff is slow. The surface layer is mildly alkaline. The content of organic matter is high, the content of phosphorus is low, and the content of potassium is high. The seasonal high water table is at a depth of 3 to 6 feet.

Most areas are cropped. This soil has good potential for cultivated crops, hay, pasture, range, and windbreaks. It has poor potential for most engineering uses.

This soil is well suited to all of the crops commonly grown in the county. It has few or no limitations related to wetness or the hazard of erosion. It is subject to occasional overflow, but more commonly the nearby slightly lower lying Lamoure soils are flooded, thus making the areas of this soil inaccessible. Grassed waterways are needed in some areas to divert the runoff from adjoining uplands. An occasional crop of legumes and grasses helps to keep the surface layer loose and porous and the underlying layers permeable.

The potential of this soil for the trees and shrubs needed in windbreaks is good. Few soil characteristics are detrimental to the growth and survival of the commonly grown trees and shrubs. Texture and drainage characteristics allow deep penetration of moisture and roots and uniform distribution of roots. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides.

This soil has poor potential for most engineering uses because of the occasional flooding. Before local roads are constructed across areas of this soil, onsite investigation is needed to determine the flood hazard and proper design. The underlying material is suitable as roadfill in the subgrade if road ditches provide good drainage, but stronger material that is less susceptible to frost action is needed in the base. This soil is a good source of topsoil. The included La Prairie soils that are not subject to overflow are fairly well suited to septic tank absorption fields, dwellings, and local roads. Capability subclass IIw; Overflow range site.

70—Svea loam, 1 to 3 percent slopes. This nearly level, moderately well drained soil is on the lower parts of side slopes, on the upper parts of drainageways, and in other slightly concave, irregularly shaped areas in the glaciated uplands. A few stones and boulders are on the surface and in the soil. Individual areas range from 3 to 25 acres in size.

Typically, the surface layer is loam about 21 inches thick. The upper part is black, and the lower part is very dark gray, black, very dark grayish brown, and olive brown and has many worm casts. The subsoil is loam about 16 inches thick. It is dark grayish brown in the upper part and olive brown and calcareous in the lower part. The underlying material to a depth of about 60 inches is light olive brown, mottled, calcareous loam glacial till. In some areas the surface layer and subsoil are clay loam.

Included with this soil in mapping are small areas of Hamerly, Darnen, and Flom soils. These soils make up 3 to 10 percent of the unit. The moderately well drained Hamerly and Darnen soils are in convex spots and on foot slopes. The poorly drained Flom soils are in narrow, shallow drainageways.

Permeability is moderate, available water capacity is high, and surface runoff is medium to slow. The surface layer is neutral, and the subsoil typically is mildly alkaline. The content of organic matter is high, the content of phosphorus is very low, and the content of potassium is medium or high. The seasonal high water table is at a depth of 4 to 6 feet.

Most areas are cropped. This soil has good potential for cultivated crops and windbreaks. It has good or fair potential for most engineering uses.

This soil is well suited to all of the crops commonly grown in the county. It has few limitations and can be cropped intensively. This moderately well drained soil does not dry out so quickly in spring as the nearby well drained Barnes soil and cannot be worked so early. Leaving crop residue on the surface of fall-plowed fields helps to control soil blowing. An occasional green manure or sod crop helps to maintain good structure and tilth.

This soil is well suited to the trees and shrubs needed in windbreaks. Texture and drainage characteristics allow deep penetration of moisture and roots and uniform distribution of roots. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or by approved herbicides. If the site for a windbreak is in sod, plowing and disking during the summer or fall before

planting increase the moisture supply and kill unwanted vegetation.

The seasonal high water table adversely affects many engineering uses. It is normally controlled on sites for dwellings with basements by installing tile around the footings. Septic tank absorption fields work poorly during wet periods when the water table is high. If local roads and streets are built on this soil, a stronger base material that can support traffic and can overcome the hazard of frost action and shrinking and swelling is needed. This soil is a good source of topsoil. The small areas of the included better drained soils provide possible sites for dwellings and septic tank absorption fields. Special design or precautions are needed if small areas of the included Flom soils are on the construction site. The seasonal high water table is shallower than that in the Svea soil. Capability class I.

86—Canisteo clay loam. This nearly level, poorly drained, calcareous soil is on the rims of depressions and in other low, wet areas on the floor of the lowland plain and in a few areas, in the southeastern part of the county, is intermingled with Everly and Wilmonton soils. Lime has accumulated in the surface layer, which is grayish when dry (fig. 8). Slopes are plane or slightly convex. Areas of this soil are generally intermingled with areas of other soils. They range from 3 to several hundred acres in size.

Typically, the surface layer is clay loam about 22 inches thick. It is black in the upper part and black and mottled with grayish brown in the lower part. The subsoil is grayish brown, mottled, friable clay loam about 9 inches thick. The underlying material to a depth of about 60 inches is grayish brown and light olive gray, mottled loam glacial till. It contains numerous crystals of gypsum. This soil is calcareous throughout.

Included with this soil in mapping are small areas of poorly drained soils that are leached of carbonates in the surface layer and subsoil. Also included are small areas of Glencoe and Seaforth soils. The poorly drained, leached soils are in drainageways and on wet flats at a slightly higher elevation than the Canisteo soil. The very poorly drained Glencoe soils are in shallow depressions. The moderately well drained Seaforth soils are on islands and knolls within areas on the Canisteo soil or on peninsulas that extend into those areas. Included soils make up 5 to 25 percent of the unit.

Permeability is moderate, surface runoff is slow, and available water capacity is high. The surface layer is mildly alkaline or moderately alkaline. The soil contains an excessive amount of lime, and in some spots it also contains an excessive amount of gypsum. The content of organic matter is high, the content of phosphorus is low or very low, and the content of potassium is medium or high. The seasonal high water table is at a depth of 1 foot to 3 feet in spring and during wet periods in all areas but those that have been artificially drained.

Most areas are cropped. Some areas where more drainage is needed are used for grazing. This soil has good potential for cultivated crops. It has fair to poor potential for windbreaks and poor potential for most engineering uses.

This soil is suited to intensive cropping if it is adequately drained and adequately fertilized and if all crop residue is returned. The soil dries out and warms up slowly in spring. Tile is needed to provide subsurface drainage. If crop growth is poor after adequate drainage has been provided, a liberal amount of potassium and phosphorus is needed in fertilizers. These nutrients help to correct the fertility imbalance caused by the high content of lime. The ground water in some areas contains enough magnesium sulfate to cause disintegration of ordinary cement tile. Clay tile or alkali-resistant tile should be used. Fall plowing permits rapid preparation of a seedbed in spring.

The potential of this soil for the trees and shrubs needed in windbreaks is fair to poor. The wetness and the high content of lime reduce the number of species that can grow well. The excessive amount of lime interferes with the uptake of nutrients in many woody plants. Chlorosis, which generally is caused by a deficiency of available iron, occurs in many trees and shrubs on soils that have a high content of lime. This condition is best controlled by planting trees and shrubs that can tolerate the high content of lime. Drainage lowers the seasonal high water table and favors deeper rooting. Site preparation should be completed in the fall before planting because in many years working the soil when it is too wet early in spring can cause clodding. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides.

This soil has poor potential for building site development and most engineering uses because it is wet. Dwellings and small buildings are most suitable on this soil if they are constructed without basements. Artificial drainage and control of surface water are needed. Foundations and footings should be designed to prevent the structural damage caused by frost action.

Standard septic tank absorption fields are not suited because of the seasonal high water table. In places mound-type absorption fields are suitable. If local roads are to function properly, a cover of suitable base material is needed. Surface water can be removed by adequately designed road ditches. Capability subclass IIw; not assigned to a range site.

114—Glencoe silty clay loam. This nearly level, very poorly drained soil is in shallow depressions in the lowland plain. It is subject to flooding. Generally, no stones are on the surface or in the soil. Individual areas range from 3 to 80 acres in size.

Typically, the surface layer is black silty clay loam and clay loam about 42 inches thick. The subsoil is olive gray, mottled, very firm clay loam about 5 inches thick. The underlying material to a depth of about 60 inches is olive gray, mottled clay loam glacial till. The soil is slightly calcareous below a depth of 42 inches. The surface layer is as thin as 24 inches in places. In a few depressional areas, a thin layer of muck is at the surface.

Included with this soil in mapping are small areas of Canisteo soils and Oldham silty clay loam. The poorly drained, calcareous Canisteo soils are along the edges of the depressions and on low knolls that are slightly higher than the floor of the depressions. The very poorly drained, calcareous Oldham soil is in small areas in some of the depressions. Included soils make up 2 to 20 percent of the unit.

Permeability is moderately slow, and available water capacity is high. Surface runoff is ponded or very slow. Typically, the surface layer is neutral, but in a few places it is slightly acid or mildly alkaline. The content of organic matter is high, the content of phosphorus is medium to low, and the content of potassium is very high. On undrained sites the water table is at or near the surface in all periods but those after a prolonged drought.

Most areas are drained and are cropped. This soil has good potential for cultivated crops and hay crops. It has fair potential for windbreaks and poor potential for most engineering uses. Undrained areas are marshy and have good potential for wetland wildlife habitat.

If drained, this soil is well suited to all of the crops commonly grown in the county. The major limitation is wetness. Practices that reduce compaction and maintain good tilth are needed. Tile is needed to provide subsurface drainage. Open ditches can drain surface water and in places provide outlets for tile drains. Fall plowing permits rapid preparation of a seedbed in spring. If fall-plowed fields are left rough and some residue is left on the surface, soil blowing can be controlled. If this soil is worked when too wet, hard clods that are difficult to break form. An occasional sod or green manure crop helps to maintain good tilth in the surface layer.

In areas where surface water is not a problem, this soil has fair potential for the trees and shrubs needed in windbreaks. If adequate subsurface drainage is provided, more kinds of trees and shrubs can be grown successfully. Site preparation should be completed during the fall before planting because in many years working the soil early in spring when it is too wet causes clodding. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides.

As a result of the wetness, the flood hazard, and the susceptibility to frost action, this soil is poorly suited to most engineering uses. The wetness and the flood hazard can be overcome by open drainage ditches or drainage tile. Onsite investigation is needed to determine the best method for a particular area. Septic tank absorption fields are poorly suited to this soil because of the seasonal high water table and the moderately slow permeability. Capability subclass IIIw; not assigned to a range site.

127—Sverdrup sandy loam, 0 to 2 percent slopes. This nearly level, somewhat excessively drained soil is on hilltops and in gentle swales on glaciated uplands and lowland plains and on beaches on the lake plain. In most cropped areas the surface layer is brownish. Some organic matter has been lost through cropping or erosion, and some of the brownish subsoil has been mixed into the surface layer. Individual areas range from 3 to 25 acres in size.

Typically, the surface layer is black sandy loam about 9 inches thick. The subsoil is about 23 inches thick. It is very dark grayish brown, friable sandy loam in the upper part; dark yellowish brown, very friable sandy loam in the next part; and dark yellowish brown, loose loamy sand in the lower part. The underlying material to a depth of about 60 inches is brown and pale brown, slightly calcareous medium sand.

Included with this soil in mapping are some small areas where the surface layer and subsoil are loamy sand and available water capacity is very low. Also included are a few areas where available water capacity is higher than that in the Sverdrup soil and where the surface layer and subsoil are loam that is less than 20 inches thick, glacial till or silty material is at a depth of 3 to 4 feet, or thin silty layers are in the sandy underlying material. Included areas make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the upper 2 feet and rapid in the sandy material below. The soil takes in water readily, but available water capacity is low. The surface layer is neutral or slightly acid. The content of organic matter is moderate, the content of phosphorus is very low, and the content of potassium is medium. The seasonal high water table is at a depth of more than 6 feet.

Most areas are cropped or are used for grazing. This soil has fair to poor potential for cultivated crops and fair potential for hay crops, range, and windbreaks. It has good potential for all engineering uses but those affected by seepage or the caving of cutbanks.

Corn, soybeans, small grain, and alfalfa grow fairly well in years of adequate rainfall. Because of the low available water capacity, drought is the major hazard. Soil blowing is also a hazard, particularly after fall plowing. Leaving stubble and stalks on the surface during winter helps to trap snow and conserves moisture. Minimum tillage practices, such as chisel plowing, also reduce the risk of soil blowing and moisture loss. A single-row shelterbelt reduces the risk of soil blowing and the loss of moisture through evaporation and transpiration. Wind stripcropping, or growing close-growing crops and intertilled crops in alternate narrow bands, also reduces the loss of soil and moisture.

This soil is not well suited to many tree and shrub species. The mortality rate in windbreaks is likely to be severe if drought occurs while the trees and shrubs are becoming established. It can be partly overcome by special care during site preparation and planting and by weed control. Trees planted on this soil generally grow slowly and are commonly stunted. They also tend to have a shorter life than the same species on soils that are underlain by finer textured material. Field windbreaks are effective in controlling soil blowing, but care is needed to keep young trees or shrubs from being damaged by windblown particles of soil. A cover of grass or of crop residue from corn or small grain reduces the risk of soil blowing.

This soil is generally a good source of topsoil, sand, and roadfill. It is suitable for building site development and local roads and streets. Septic tank absorption fields work well on this soil, but contamination of underground water is a hazard because of seepage and rapid permeability. Also, cutbanks in shallow excavations can cave. Providing retaining walls or enlarging the excavation can overcome this hazard. Capability subclass IIIs; Sandy range site.

127B—Sverdrup sandy loam, 2 to 6 percent slopes. This somewhat excessively drained soil is on sandy ridges, in pockets, and on side slopes. It is undulating in the glaciated uplands and on the lowland plain and gently sloping on stream terraces. Most cropped areas have a brownish cast as a result of the loss of organic matter through cropping and erosion and through mixing of the brownish subsoil into the surface layer. Individual areas are irregular in shape and range from 3 to 40 acres in size.

Typically, the surface layer is black sandy loam about 9 inches thick. The subsoil is about 23 inches thick. The upper part is very dark grayish brown, friable sandy loam; the next part is dark yellowish brown, very friable sandy loam; and the lower part is dark yellowish brown, loose loamy sand. The underlying material to a depth of about 60 inches is brown and pale brown, slightly calcareous medium sand.

Included with this soil in mapping are a few areas where the sandy material is only a few feet thick over glacial till or silty material and a few other areas where thin layers of silty material are in the underlying material. Available water capacity is slightly higher in these areas than in the Sverdrup soil. Also included are a few small areas where the surface layer and subsoil are loamy sand and available water capacity is lower than that in the Sverdrup soil. Included areas make up 5 to 20 percent of the unit.

Permeability is moderately rapid, and surface runoff is slow. Available water capacity is low because the soil is underlain by sand or loamy sand at a depth of 1 foot to 2 feet. The surface layer is neutral or slightly acid. The content of organic matter is moderate, that of phosphorus is very low, and that of potassium is medium. The seasonal high water table is at a depth of more than 6 feet.

Most areas are cropped or used for grazing. This soil has fair to poor potential for cultivated crops, range, hay crops, and windbreaks. It has good potential for all engineering uses but those affected by seepage and the caving of cutbanks.

Corn, small grain, and alfalfa are fairly well suited to this soil, especially in years when the rainfall is both adequate and timely. The hazard of drought is moderately severe. The soil is easy to work, but it is subject to soil blowing unless it is protected. Minimum tillage and the return of all crop residue to the soil help to control erosion and conserve moisture in areas where slopes are too irregular for contouring. Spring plowing helps to control erosion and soil blowing, especially soil blowing. Leaving stubble on the surface during winter helps to trap snow and conserves moisture. A single-row shelterbelt helps to control erosion and conserve moisture.

This soil is not well suited to many tree and shrub species. The mortality rate in windbreaks is likely to be severe if drought occurs while the trees and shrubs are becoming established. It can be partly overcome by special care during site preparation and when the trees and shrubs are planted and by weed control. Trees planted on this soil generally grow slowly and are commonly stunted. Also, they tend to have a shorter life than the same species on soils that are underlain by finer textured material. Field windbreaks are effective in controllng soil blowing, but care is needed to keep young trees and shrubs from being damaged by windblown particles of soil. A cover of grass or of crop residue from corn or small grain reduces the risk of soil blowing.

This soil is suitable for building site development and local roads and streets. It is generally a good source of topsoil, sand, and roadfill. Septic tank absorption fields work well, but contamination of underground water is a hazard because of seepage and rapid permeability. Also, cutbanks in shallow excavations can cave. Building retaining walls or enlarging the excavation can overcome this hazard. Capability subclass IIIs; Sandy range site.

149B—Everly clay loam, 2 to 4 percent slopes. This gently undulating, well drained soil is on slightly elevated, convex rises and on gentle side slopes that enclose drainageways on the glaciated landscape. A few stones and boulders are on the surface and in the soil. Slopes are complex, slightly convex, and 125 to 200 feet long. Most areas range from 3 to 100 acres in size.

Typically, the surface layer is very dark gray clay loam about 10 inches thick. The subsoil is friable to firm clay loam about 16 inches thick. The upper part is brown and has many very dark gray worm casts, and the lower part is dark yellowish brown. The underlying material to a depth of about 60 inches is yellowish brown, calcareous loam glacial till mottled with gray. Some small areas are more sloping and are eroded.

Included with this soil in mapping are small areas of poorly drained Letri soils and moderately well drained Wilmonton soils. These soils make up 5 to 15 percent of the unit. The Letri soils occupy drainageways, and the Wilmonton soils are in swales and the saddle of side slopes. Also included, next to the flood plain of the Cottonwood River, are small areas of the sandy Sverdrup soils and Arvilla, Sioux, and Fordville soils, which are underlain by gravelly material. These soils make up 2 to 10 percent of the unit.

Permeability is moderate in the surface layer and subsoil and moderately slow in the underlying material. Available water capacity is high. Surface runoff is medium. Reaction is neutral in the surface layer. The content of organic matter is high, the content of phosphorus is very low, and the content of potassium is medium or high. The seasonal high water table generally is at a depth of more than 6 feet.

Most areas are cropped. This soil has good potential for cultivated crops, hay, pasture, and windbreaks. It has fair potential for most engineering uses.

This soil is suited to all of the crops commonly grown in the county. The hazard of erosion is slight. Stones are sometimes pushed to the surface by tillage and by frost action. Tillage is easier if the stones are removed periodically. Most areas are not well suited to terracing and contour farming. In areas where erosion is a problem, mimimum tillage practices, such as chisel plowing, help to control erosion. Leaving crop residue on the surface and keeping the surface rough reduce the risk of soil blowing on fall-plowed fields during winter and spring. An occasional green manure or sod crop helps to maintain good structure and tilth. Grassed waterways are needed in areas where water collects on and crosses this soil.

This soil is well suited to the trees and shrubs needed in windbreaks. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or by approved herbicides. If the site for a windbreak is in sod, plowing and disking during summer or fall before planting increase the moisture supply and kill unwanted vegetation.

This soil is suitable for septic tank absorption fields and for sanitary landfills. The moderately slow permeability, a limitation in septic tank absorption fields, can be overcome by increasing the size of the absorption area. Good drainage and a cover of suitable material are needed to prevent the structural damage to foundations, footings, and floors of dwellings that is caused by settlement and shrinking and swelling.

If used as roadfill, this soil is suitable as subgrade material, but stronger material that is less susceptible to frost action is needed in the base. This soil is only moderately suitable as a site for local roads and streets because the susceptibility to frost action and the shrink-swell potential are moderate. In most of the small areas of contrasting soils that are included in this unit, the seasonal high water table is within a depth of 6 feet. These areas have moderate or severe limitations for most engineering uses, depending on depth to the water table. Capability subclass IIe; not assigned to a range site.

149B2—Everly clay loam, 3 to 6 percent slopes, eroded. This undulating, well drained soil is at the higher elevations on the glacial landscape. A few stones and boulders are on the surface and in the soil. Slopes are complex, convex, and 100 to 200 feet long. The surface has a grayish cast because erosion has occurred and the subsoil has been mixed with the surface layer or is exposed in spots. Most areas range from 3 to 80 acres in size.

Typically, the surface layer is very dark gray clay loam about 8 inches thick. The subsoil is friable to firm clay loam about 14 inches thick. The upper part is brown and has many very dark gray worm casts, and the lower part is dark yellowish brown. The underlying material to a depth of about 60 inches is yellowish brown, calcareous loam glacial till mottled with gray.

Included with this soil in mapping are small areas of Storden and Wilmonton soils. These soils make up 2 to 7 percent of the unit. The well drained, calcareous Storden soils are on the steepest, most exposed convex parts of hillsides. The moderately well drained Wilmonton soils are in swales and saddles between areas of Everly soils. In small areas adjacent to the flood plain of the Cottonwood River, pockets of sand and gravel are evident. Included in mapping in these small areas are Sverdrup soils, which are underlain by sandy material, and Arvilla, Fordville, and Sioux soils, which are underlain by gravelly material. These soils make up 5 to 10 percent of the unit.

Permeability is moderate in the surface layer and subsoil and moderately slow in the underlying material. Available water capacity is high. Surface runoff is medium. Reaction is neutral in the surface layer. The content of organic matter is moderate to high, the content of phosphorus is very low, and the content of potassium is medium or high. The seasonal high water table is at a depth of more than 6 feet.

Most areas are cropped. This soil has good potential for cultivated crops, hay, pasture, and windbreaks. It has fair potential for most engineering uses.

This soil is suited to all of the crops commonly grown in the county. The hazard of erosion is moderate. Stones are sometimes pushed to the surface by tillage and by frost action. Tillage is easier if the stones are removed periodically. If the slopes are suitable, contouring is effective in controlling erosion and holding water on the soil. Minimum tillage practices, such as chisel plowing, also help to control erosion, particularly in areas not suitable for contouring. Leaving crop residue on the surface and keeping the rough surface reduce the risk of soil blowing on fall-plowed fields during winter and spring. An occasional green manure or sod crop helps to maintain good structure and tilth. Grassed waterways are needed in areas where water collects on and crosses this soil.

This soil is suited to the trees and shrubs needed in windbreaks. Water erosion and soil blowing can be controlled by maintaining a mulch of crop residue on the surface. In places windbreaks can be planted on the contour. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbecides. If the site for a windbreak is in sod, plowing and disking during the summer or fall before planting increase the moisture supply and kill unwanted vegetation.

The soil has moderate suitability for septic tank absorption fields, building sites, and local roads. The moderately slow permeability, a limitation in septic tank absorption fields, can be overcome by increasing the size of the absorption area. If buildings or roads are constructed on this soil, surface drainage around the buildings and along the roadways is needed. Also, a cover of more suitable base material is needed for roads. Capability subclass IIe; not assigned to a range site.

149C2—Everly clay loam, 6 to 12 percent slopes, eroded. This sloping, well drained soil is on the sides of drainageways around shallow upland depressions. A few

stones and boulders are on the surface and in the soil. On the crests of some slopes near streams, small pockets of sand and gravel are exposed. Shallow drainageways dissect the slopes at irregular intervals. Slopes are simple, convex, and 150 to 200 feet long. Individual areas are mostly long and narrow and range from 3 to 20 acres in size.

Typically, the surface layer is very dark gray clay loam about 7 inches thick. The subsoil is friable to firm clay loam about 14 inches thick. It is brown in the upper part and dark yellowish brown in the lower part. The underlying material to a depth of about 60 inches is yellowish brown, calcareous loam glacial till mottled with gray. In pastures and other uncultivated areas, the soil is not eroded and has a thicker surface layer.

Included with this soil in mapping are narrow areas of Darnen soils and spots of Storden soils. These soils make up 5 to 15 percent of the unit. The Darnen soils are in shallow drainageways and at the foot of hillsides. The Storden soils are on the steepest, most exposed parts of side slopes.

Permeability is moderate in the surface layer and subsoil and moderately slow in the underlying material. Available water capacity is high. Surface runoff is rapid. Reaction is neutral in the surface layer. The content of organic matter is moderate, the content of phosphorus is very low, and the content of potassium is medium or high. The seasonal high water table is at a depth of more than 6 feet.

Most areas are cropped. This soil has fair potential for cultivated crops, good potential for hay and pasture crops and windbreaks, and fair potential for most engineering uses.

If erosion is controlled and fertility is maintained, this soil is well suited to the crops commonly grown in the county. The hazard of further erosion is moderate to severe. In areas where slopes are too irregular for terracing and contouring, a high level of management and a rotation that includes a meadow crop, which helps to control runoff and erosion, are needed. A high level of management includes spring plowing, heavy applications of manure, the return of all crop residue to the soil, and disking instead of plowing for the small grain crop that follows corn in the rotation. Grassed waterways are needed in areas where water collects.

This soil is suited to the trees and shrubs needed in windbreaks. Erosion can be controlled by planting on the contour or by maintaining a mulch of crop residue. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides. If the site for a windbreak is in sod, plowing and disking during the summer or fall before planting increase the moisture supply and kill unwanted vegetation.

The hazard of erosion is a concern for most engineering uses. It can be controlled on the shoulders and sides of roads by seeding, mulching, and sodding. If dwellings are built on the less sloping foot slopes or ridgetops, it is easier to control. The hazard of frost heave can be partly overcome on roads by providing good surface drainage and by using material that is less subject to frost heave in the base. Properly installing septic tank absorption fields is difficult because of the slope. Capability subclass IIIe; not assigned to a range site.

168B—Forman clay loam, 2 to 4 percent slopes. This gently undulating, well drained soil is on the convex parts of the Coteau slope. It also is on slight knolls in nearly level areas and along some drainageways. A few stones and boulders are on the surface and in the soil. Slopes are complex, slightly convex, and 125 to 200 feet long. Most areas are slightly long and range from 3 to 175 acres in size.

Typically, the surface layer is clay loam about 11 inches thick. It is black and very dark gray in the upper part and very dark gray and dark brown in the lower part. The subsoil is about 14 inches thick. It is dark brown, firm clay loam in the upper part and light olive brown, calcareous, friable clay loam in the lower part. The underlying material to a depth of about 60 inches is grayish brown, calcareous clay loam glacial till.

Included with this soil in mapping are small areas of more sloping and eroded Forman soils and Flom and Aastad soils. These soils make up 5 to 15 percent of the unit. The poorly drained Flom soils are in narrow, shallow drainageways, and the moderately well drained Aastad soils are in slightly concave areas. Also included, next to the lake plain, are small areas of Poinsett soils, which are silty; Sverdrup soils, which are underlain by sandy material; and Arvilla soils, which are shallow over gravelly material. These soils make up 2 to 10 percent of the unit.

Permeability is moderate in the surface layer and subsoil and moderately slow in the underlying material. Available water capacity is high, and surface runoff is medium. The surface layer typically is neutral but is slightly acid in a few places. The content of organic matter is high, the content of phosphorus is low, and the content of potassium is medium or high. The seasonal high water table is generally at a depth of 6 feet or more.

Most areas are cropped. This soil has good potential for cultivated crops, hay, range, and windbreaks. It has fair potential for most engineering uses.

This soil is suited to all of the crops commonly grown in the county. The hazard of erosion is slight. Stones are sometimes pushed to the surface by tillage and by frost action. Tillage is easier if the stones are removed periodically. Most areas are generally not well suited to terracing and contour farming. In areas where erosion is a problem, minimum tillage practices, such as chisel plowing, help to control erosion. Leaving crop residue on the surface and keeping the surface rough reduce the risk of soil blowing on fall-plowed fields during winter and spring. An occasional green manure or sod crop helps to maintain good structure and tilth. Grassed waterways are needed wherever water collects on and crosses this soil.

This soil is well suited to the trees and shrubs needed in windbreaks. Weeds and grasses can be controlled in

newly established windbreaks by shallow cultivation or approved herbicides. If the site for a windbreak is in sod, plowing and disking during the summer or fall before planting increase the moisture supply and kill unwanted vegetation.

This soil is moderately suitable as a site for buildings and local roads and streets. By increasing the size of the absorption areas, the limitation of moderately slow permeability can be overcome in septic tank absorption fields. If the soil is used as a site for dwellings without basements, soil material that is less susceptible to shrinking and swelling is needed below the floor. If buildings and roads are constructed on this soil, good drainage, proper design, and a cover of suitable material can overcome the moderate frost action, the low strength, and the shrink-swell potential. Special design or precautions are needed if small areas of the included Flom soils occur on the construction site. These soils have a more shallow seasonal high water table than the Forman soil. Capability subclass IIe; Silty range site.

168B2—Forman clay loam, 3 to 6 percent slopes, eroded. This undulating, well drained soil is on the convex parts of the Coteau slope. It is also along drainageways and around closed depressions. A few stones and boulders are on the surface. The brownish subsoil is exposed in spots. Slopes are mostly complex, convex, and 100 to 200 feet long. Most areas are slightly long and range from 3 to 200 acres in size.

Typically, the surface layer is very dark gray clay loam about 7 inches thick. The subsoil is about 14 inches thick. It is dark brown, firm clay loam in the upper part and light olive brown, calcareous, friable clay loam in the lower part. The underlying material to a depth of about 60 inches is grayish brown, calcareous clay loam glacial till. The till is loam in places.

Included with this soil in mapping are areas of the poorly drained Flom soils in narrow drainageways and small, slightly concave areas of the moderately well drained Aastad soils. These soils make up 2 to 6 percent of the unit. Also included, next to the lake plain, are small areas of Poinsett soils, which are silty; Sverdrup soils, which are underlain by sandy material; and Arvilla soils, which are shallow to gravelly material. These soils make up 2 to 5 percent of the mapped areas next to the lake plain.

Permeability is moderate in the surface layer and subsoil and moderately slow in underlying material. Available water capacity is high, and surface runoff is medium. Reaction is neutral in the surface layer. The content of organic matter is moderate or high, the content of phosphorus is low, and the content of potassium is medium or high. The seasonal high water table is at a depth of more than 6 feet.

Most areas are cropped. This soil has good potential for cultivated crops, hay, range, and windbreaks. It has fair potential for most engineering uses.

This soil is suited to all of the crops commonly grown in the county. The hazard of erosion is moderate. Stones are sometimes pushed to the surface by tillage and by frost action. Tillage is easier if the stones are removed periodically. If the slopes are suitable, contouring is effective in controlling erosion and in holding water on the soil. Minimum tillage practices, such as chisel plowing, also help to control erosion, particularly in areas that are not suited to contouring. Leaving crop residue on the surface and keeping the surface rough reduce the risk of soil blowing on fall-plowed fields during winter and spring. An occasional green manure or sod crop helps to maintain good structure and tilth. Grassed waterways are needed in areas where water collects on and crosses this soil.

This soil is suited to the trees and shrubs needed in windbreaks. Erosion can be controlled by maintaining a mulch of crop residue on the surface. In places windbreaks can be planted on the contour. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides. If the site for a windbreak is in sod, plowing and disking during the summer or fall before planting increase the moisture supply and kill unwanted vegetation.

This soil is moderately suitable as a site for septic tank absorption fields, buildings, and local roads. The moderately slow permeability, a limitation in septic tank absorption fields, can be overcome by increasing the size of the absorption area. If the soil is used as a site for dwellings without basements, soil material that is less susceptible to shrinking and swelling is needed below the floor. If roads are constructed on this soil, surface drainage along the roadway and a cover of more suitable base material can help to overcome the moderate frost action, the low strength, and the shrink-swell potential. Special design or precautions are needed if small areas of the included Flom soils are on the construction site. These soils have a more shallow seasonal high water table than the Forman soil. Capability subclass IIe; Silty range site.

184—Hamerly loam, 1 to 3 percent slopes. This nearly level, somewhat poorly drained and moderately well drained, calcareous soil is on the low, complex knolls or islands among wet soils and on the low peninsulas in the glaciated uplands. Slopes are convex and complex and are less than 100 feet long. Individual areas range from 3 to 10 acres.

Typically, the surface layer is loam about 17 inches thick. It is black in the upper part and very dark gray and dark grayish brown in the lower part. The subsoil is dark grayish brown, mottled, friable loam about 9 inches thick. The underlying material to a depth of about 60 inches is light olive brown and gray, mottled loam glacial till. Layers of light clay loam, sandy clay loam, and heavy sandy loam are in some areas. The soil is dominantly calcareous throughout, but in places the surface layer has been mostly leached of free lime. Pockets of gypsum are in the subsoil and underlying material in many areas.

Included with this soil in mapping are small areas of the poorly drained Vallers soils at a slightly lower elevation and small spots of Quam soils in depressions. These soils make up 2 to 10 percent of the unit.

Permeability is moderate in the surface layer and subsoil and moderately slow or moderate in the underlying material. Available water capacity is high, and surface runoff is medium to slow. The surface layer is mildly alkaline or moderately alkaline because the content of lime is high. The content of organic matter is high, the content of phosphorus is low, and the content of potassium is medium. The seasonal high water table is at a depth of 3 to 5 feet.

Except for small tracts that lie within the larger undrained areas of wet soils, most areas are cropped. This soil has good potential for cultivated crops and hay. It has fair potential for windbreaks and fair to poor potential for most engineering uses.

If adequately drained, this soil is suited to all of the crops commonly grown in the county. In places the high content of lime causes a fertility imbalance, which can be corrected by a liberal amount of potassium and phosphorus in fertilizers. The hazard of soil blowing is slight. Drainage is not needed on this soil, but drainage of the adjoining soils makes this soil easier to manage. Leaving crop residue on the surface reduces the risk of soil blowing on fall-plowed fields during winter and spring.

The potential of this soil for the trees and shrubs needed in windbreaks is fair. The high content of lime adversely affects the uptake of plant nutrients. Chlorosis, which results from a lack of iron, occurs in the plants growing on this soil. This condition is best controlled by planting trees and shrubs that are tolerant of a high content of lime. Soil blowing can be controlled on bare knobs by maintaining a mulch of crop residue. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides.

The use of this soil as a septic tank absorption field is restricted by the seasonal high water table in some areas. It is also restricted by the moderate or moderately slow permeability, but this limitation can be overcome by increasing the size of the absorption area. Unheated buildings without basements and local roads and streets are adversely affected by frost action and shrinking and swelling unless good drainage is provided and the soil is covered with suitable base material. Placing drainage tile along the outside of the footings is a suitable method of controlling the water table on sites where dwellings have basements. Capability subclass IIs.

210—Fulda silty clay. This nearly level, poorly drained soil is on wet flats and in drainageways at the lowest elevation of ice-walled lake plains. In some areas it is flooded during snowmelt in spring or after heavy rains. Individual areas range from 3 to 20 acres in size.

Typically, the surface layer is black silty clay about 17 inches thick. The subsoil is mottled, firm silty clay about 11 inches thick. It is very dark gray to very dark grayish brown in the upper part and grayish brown and slightly calcareous in the lower part. The underlying material to a depth of about 60 inches is gray, mottled, calcareous, lake-deposited sediments of silty clay. In some small areas the surface layer is calcareous. In drainageways and near the base of slopes, it is more than 24 inches thick. In places gypsum crystals are in the parent material.

Included with this soil in mapping are small clayey depressions that are very poorly drained and small islands of moderately well drained Sinai soils. These included areas make up 2 to 8 percent of the unit.

Permeability is slow, available water capacity is high, and surface runoff is slow. The surface layer is neutral in most places, but in some spots it is mildly alkaline. The content of organic matter is high, the content of phosphorus is low, and the content of potassium is medium to high. The shrink-swell potential is high. The seasonal high water table is at a depth of 1 foot to 3 feet unless the soil has been artificially drained.

Most areas are cropped. A few areas where more drainage is needed are used for grazing. This soil has good to fair potential for cultivated crops. It has fair potential for windbreaks and poor potential for most engineering uses.

This soil is well suited to corn, soybeans, small grain, and legume-grass hay if adequate drainage is provided. Because of the wetness and the clayey texture, careful management is needed to maintain good tilth. Tile is needed to provide subsurface drainage. Alfalfa, sweet clover, and other deep-rooted legumes open channels in the clayey subsoil and help to maintain adequate drainage. The soil dries out and warms up slowly in spring. Fall plowing permits rapid preparation of a seedbed in spring. Hard clods are likely to form if the soil is plowed or worked when wet. A rough plowed surface and some crop residue on the surface reduce the risk of soil blowing.

Unless surface water is a problem, this soil has fair potential for the trees and shrubs needed in windbreaks. It is too clayey for optimum growth. If adequate subsurface drainage is provided, more kinds of trees and shrubs can be grown successfully. Site preparation should be completed the fall before planting because clods form in many years if the soil is worked early in spring when it is too wet. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides.

This soil has poor potential for building site development. Artificial drainage and control of surface water are needed. Dwellings and small buildings should be constructed without basements, and foundations and footings should be designed to prevent the structural damage caused by frost action and by shrinking and swelling. Septic tank absorption fields are poorly suited because of wetness and slow permeability. A cover of suitable material is needed if local roads are to function properly. Capability subclass IIw.

212—Sinai silty clay, 1 to 3 percent slopes. This nearly level, moderately well drained soil is on flat hilltops that were formerly parts of ice-walled lake plains. Slopes are simple and are several hundred feet long. Individual areas range from 3 to 60 acres in size.

Typically, the surface layer is black and very dark grayish brown silty clay about 17 inches thick. The subsoil is firm silty clay about 16 inches thick. The upper part is very dark grayish brown and brown, and the lower part is dark grayish brown and mottled. The subsoil has a few tongues of material from the surface layer. The underlying material to a depth of about 60 inches is light olive brown and light olive gray, mottled, lake-deposited sediments of silty clay loam. In a few places the surface layer is calcareous.

Included with this soil in mapping are a few areas where glacial till is within a depth of 40 inches. Also included are small areas of Fulda and Poinsett soils, which make up 2 to 15 percent of the unit. The poorly drained Fulda soils are in the lower, more concave areas. The well drained Poinsett soils are in areas where the lake-deposited sediments are more silty and less clayey.

Permeability is slow, and surface runoff is slow to medium. Available water capacity is high. The surface layer is slightly acid or neutral. The content of organic matter is high, the content of phosphorus is low, and the content of potassium is medium or high. The shrink-swell potential is high. The seasonal high water table is typically at a depth of more than 6 feet but is at a depth of 3 to 6 feet for short periods.

Most areas are cropped. This soil has good potential for cultivated crops, hay crops, range, and windbreaks. It has poor potential for most engineering uses.

This soil is well suited to corn, soybeans, small grain, flax, and legume-grass hay. It is clayey and somewhat difficult to work. The hazard of erosion is slight to moderate. Wind is likely to blow the fine particles in the surface layer if the soil is bare. If the soil is plowed when too wet, a dense, compact tillage pan develops below the plow layer and hard clods that are difficult to break form. Alfalfa, sweet clover, and other deep-rooted legumes open channels in the clayey subsoil and help to maintain adequate drainage. If the soil is plowed in the fall, a rough surface and some crop residue on the surface reduce the risk of soil blowing. Grassed waterways help to control water that flows across this soil.

This soil is suited to the trees and shrubs needed in windbreaks. The hazard of seedling mortality is moderate during the first year because the texture is clayey. It can be partly overcome by not planting the seedlings when the soil is too wet. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides.

The potential for most engineering uses is poor because permeability in this clayey soil is slow and the shrink-swell potential is high. If buildings are constructed on this soil, foundations and footings should be designed to prevent the structure damage caused by shrinking and swelling. Providing surface drainage around the buildings and placing tile along the outside of the footings of basements help to keep the soil from becoming saturated. Road ditches that provide good surface drainage and suitable base material are needed for local roads. This clayey soil is hard to work when too wet or too dry. Septic tank absorption fields work poorly because of the slow permeability. Special design or precautions are needed if small areas of the included Fulda soils occur on the construction site. These soils have a more shallow seasonal high water table than the Sinai soil. Capability subclass IIs; Clayey range site.

219—Rolfe loam. This nearly level, poorly drained soil is in very shallow, closed depressions. It is subject to flooding. In many cultivated areas the surface layer is very dark gray because it has been mixed with some of the grayish subsurface layer. Individual areas are small, mostly only a few acres in size.

Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is dark gray and very dark gray, mottled loam about 12 inches thick. The subsoil is about 31 inches thick. The upper 6 inches is very dark gray, firm clay; the next 6 inches is dark grayish brown, mottled, firm clay; and the lower 19 inches is olive gray, mottled, firm or friable clay loam. The underlying material to a depth of about 60 inches is olive, mottled, calcareous loam that has thin layers of sand and gravel. In some areas the grayish subsurface layer does not occur, and in small areas in some depressions Glencoe soils have formed.

Permeability is slow, and available water capacity is high. Surface runoff is very slow or ponded. The surface layer and subsoil typically are slightly acid or medium acid. This is the most acid soil in the county. The content of organic matter is high, and the content of phosphorus and potassium is very high. The availability of phosphorus is low. In undrained areas the seasonal high water table is at a depth of 0 to 3 feet in spring and during wet periods.

Most areas are cropped. Undrained areas mostly have marsh vegetation; some are grazed. This soil has good potential for cultivated crops, hay, and pasture and fair potential for windbreaks. It has poor potential for most engineering uses.

If adequately drained and fertilized, this soil is well suited to all of the crops commonly grown in the county. The major limitation is wetness. Management that reduces compaction and maintains good tilth is needed. Tile is needed to provide subsurface drainage, but the slowly permeable subsoil reduces the effectiveness of tile. Open ditches drain away surface water and in places provide outlets for tile drains. Fall plowing permits rapid preparation of a seedbed in spring. If fall-plowed fields are left rough and some residue is left on the surface, soil blowing can be controlled. If this soil is worked when too wet, hard clods that are difficult to break can form. An occasional sod or green manure crop helps to maintain good tilth in the surface layer.

Unless surface water is a problem, this soil has fair potential for the trees and shrubs needed in windbreaks. The clayey subsoil restricts roots. If adequate subsurface drainage is provided, more species of trees and shrubs can be grown successfully. Site preparation should be completed the fall before planting because in many years

clods form if the soil is worked early in spring when it is too wet. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides.

This soil is poorly suited to most engineering uses. Dwellings without basements can be built if suitable fill material is hauled in to raise the site several feet above the floor of the depression. Control of surface water is needed. Septic tank absorption fields are poorly suited because of the seasonal high water table, the flooding, and the slow permeability. If the soil is used as a site for local roads, adequately designed road ditches that remove surface water are needed. Also, suitable base material should be hauled in. Capability subclass IIIw; not assigned to a range site.

236—Vallers clay loam. This nearly level, poorly drained, calcareous soil is on the edges of depressions, in wet drainageways, and on flats in the glaciated uplands. Some areas are flooded during snowmelt in spring or after heavy rains. The surface layer in most plowed fields has a light colored crust when it dries. Slopes are plane or slightly convex. Individual areas are irregular in shape and range from 3 to 120 acres in size.

Typically, the surface layer is black, very dark gray, and dark grayish brown clay loam about 15 inches thick. The subsoil is dark grayish brown, mottled, friable clay loam about 10 inches thick. The underlying material to a depth of about 60 inches is grayish brown and light brownish gray, mottled loam. Fragments of snail shells are in the soil in places. In some areas the surface layer and subsoil have been sorted and redeposited by water. The reworked material is less stony and more silty than the underlying material. The soil is generally calcareous throughout, but in some areas it contains less lime than the typical Vallers soil.

Included with this soil in mapping are small areas of Hamerly, Flom, and Quam soils. These soils make up 3 to 15 percent of the unit. The moderately well drained, calcareous Hamerly soils are on islands and low knolls. The poorly drained, noncalcareous Flom soils are in drainageways and other areas that dominantly are slightly higher in elevation than the Vallers soil. The very poorly drained Quam soils are in depressions.

Permeability is moderately slow, and available water capacity is high. The surface layer is mildly alkaline or moderately alkaline because the content of lime is high. The content of organic matter is high, the content of phosphorus is very low, and the content of potassium is medium or high. The water table is at a depth of 1 foot to 3 feet in spring or during extended wet periods unless the soil has been artificially drained.

Most areas are cropped. Some areas where more drainage is needed are used for grazing. This soil has good potential for cultivated crops, fair to poor potential for windbreaks, and poor potential for most engineering uses.

This soil is suitable for intensive use if it is adequately drained and fertilized and if crop residue is returned. The soil dries out and warms up slowly in the spring. Tile is needed to provide subsurface drainage. If crop growth is poor after adequate drainage has been provided, a liberal amount of potassium and phosphorus is needed in fertilizers. These nutrients help to correct the fertility imbalance caused by the high content of lime. The ground water in places contains enough magnesium sulfate to cause disintegration of ordinary cement tile. Clay tile or alkali-resistant cement tile should be used. Fall plowing permits rapid preparation of a seedbed in spring.

The potential of this soil for the trees and shrubs needed in windbreaks is fair to poor. The wetness and the high content of lime reduce the number of species that can grow well. The excessive lime interferes with the uptake of nutrients in many woody plants. Chlorosis, which generally is caused by a deficiency of available iron, occurs in many trees and shrubs on soils that have a high content of lime. This condition is best controlled by planting trees and shrubs that can tolerate the content of lime. Drainage lowers the seasonal high water table and favors deeper rooting. Site preparation should be completed the fall before planting because in many years clods form if the soil is worked early in spring when it is too wet. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides.

This soil has poor potential for building site development and most other engineering uses because of the wetness. Dwellings and small buildings are most suitable if they are constructed without basements. Artificial drainage and control of surface water are needed. Standard septic tank absorption fields are not suited because of the seasonal high water table. In places mound-type absorption fields are suitable. If local roads are to function properly, a cover of suitable base material is needed. In addition, surface water should be removed by adequately designed road ditches. Capability subclass IIw; Subirrigated range site.

241—Letri clay loam. This nearly level, poorly drained soil is in low-lying flat areas, near the foot of slopes, and in drainageways in the glaciated uplands. Some areas are flooded during snowmelt in spring or after heavy rains. Most are slightly concave and irregular in shape and range from 3 to more than 200 acres in size.

Typically, the surface layer is clay loam about 20 inches thick. The upper part is black, and the lower part is very dark gray. The subsoil is about 15 inches thick. The upper part is dark gray, mottled, firm clay loam, and the lower part is olive gray, mottled, friable to firm clay loam. The underlying material to a depth of about 60 inches is olive gray, mottled, calcareous loam.

Included with this soil in mapping are small areas of Glencoe, Canisteo, and Wilmonton soils. These soils make up 3 to 10 percent of the unit. The Glencoe soils are in slight depressions, the calcareous Canisteo soils are on the rims of depressions, and the moderately well drained Wilmonton soils are in slightly raised positions.

Permeability is moderately slow, and available water capacity is high. After heavy rains or snowmelt in spring,

water runs off slowly. The surface layer is typically neutral, but it ranges from slightly acid to mildly alkaline. The content of organic matter is high, that of phosphorus is low, and that of potassium is medium or high. The seasonal high water table is perched between depths of 0 and 2 feet in spring and during wet periods unless the soil has been artificially drained by drainage tile.

Most areas are cropped. Some areas where more drainage is needed are used for grazing or wild hay. This soil has good potential for cultivated crops. It has fair potential for windbreaks and poor potential for most engineering uses.

Drainage is needed before this soil can be farmed intensively. If drainage is provided, all of the crops commonly grown in the county, especially corn, are suitable. The main limitation is wetness. The soil dries out and warms up slowly in spring. Tile is needed to provide subsurface drainage. Unless adequately drained, the soil sometimes must be worked when too wet. As a result, severe compaction and clodding of the surface layer are likely to occur. Fall plowing permits rapid preparation of a seedbed in spring. Large open areas are subject to soil blowing if tilth deteriorates because an inadequate amount of crop residue is returned to the soil.

Unless surface water is a problem, this soil has fair potential for the trees and shrubs needed in windbreaks. If adequate subsurface drainage is provided, more species of trees and shrubs can grow successfully. Site preparation should be completed the fall before planting because in many years clods form if the soil is worked early in spring when it is too wet. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides.

This soil has poor potential for building site development and most engineering uses because it is wet. On sites for dwellings and small buildings constructed without basements, artificial drainage and control of surface water are needed. Foundations and footings should be designed to prevent the structural damage caused by frost action and by shrinking and swelling. Septic tank absorption fields are poorly suited. In places mound-type absorption fields are suitable. If local roads are to function properly, a cover of suitable base material is needed. In addition, surface water should be removed by adequately designed road ditches. Capability subclass IIw; not assigned to a range site.

246—Marysland loam. This nearly level, poorly drained, calcareous soil is in low sandy areas on the lake plain, on stream deltas, on outwash plains, in melt water channels, and in some overflow channels that lie between the streams on the lowland plain. Some areas are flooded during snowmelt in spring or after heavy rains. Individual areas range from 5 to several hundred acres in size.

Typically, the surface layer is loam about 18 inches thick. It is black in the upper part and very dark gray, black, and dark gray in the lower part. The subsoil is dark gray, gray, and very dark gray, mottled, friable loam about 11 inches thick. The underlying material to a depth of about 60 inches is dark grayish brown, mottled fine sandy loam over gray, mottled loamy fine sand. The soil is calcareous throughout. In some areas the surface layer is 24 to 36 inches thick. If drained, these areas are a fair to good source of topsoil. In a few areas the surface layer and subsoil are leached of free lime and are typically neutral in reaction. In some areas the underlying sand is 40 to 60 inches below the surface.

Included with this soil in mapping are small areas of Colvin and Malachy soils. These soils make up 2 to 20 percent of the unit. The Colvin soils lack the sandy underlying material. The Malachy soils are at slightly higher elevations than the Marysland soil and thus are better drained.

In most areas permeability is moderate, surface runoff is slow, and available water capacity is moderate. The surface layer in most places is mildly alkaline. The content of organic matter is high, the content of phosphorus is very low, and the content of potassium is medium. The seasonal high water table is at a depth of 1 foot to 3 feet.

Most areas are cropped. Some areas where more drainage is needed are used for grazing. This soil has good to fair potential for cultivated crops, hay, and pasture and fair to poor potential for windbreaks. It has poor potential for most engineering uses.

This soil is suited to corn, soybeans, small grain, and alfalfa. The major limitation is wetness. In places the surface layer has a high content of lime, which causes a fertility imbalance. If crop growth is poor after adequate drainage has been provided, a liberal amount of potassium and phosphorus is needed in fertilizers. These nutrients correct the fertility imbalance. Fall plowing makes it possible to prepare a good seedbed quickly in spring. Hard clods are likely to form if the soil is plowed or worked when wet. Productivity is increased if adequate tile drainage is installed. If possible, installing the tile partly in the sandy underlying material is desirable.

This soil is occasionally flooded, especially by melt water during spring runoff. In some areas flooding after heavy rains during the growing season damages crops.

The potential of this soil for the trees and shrubs needed in windbreaks is fair to poor. The wetness and the high content of lime reduce the number of species that can grow well. The excessive lime interferes with the uptake of nutrients in many woody plants. Chlorosis, which is generally caused by a deficiency of available iron, occurs in many trees and shrubs on soils that have a high content of lime. This condition is best controlled by planting trees and shrubs that can tolerate the content of lime. Drainage lowers the seasonal high water table and favors deeper rooting. Site preparation should be completed during the fall before planting because in many years clods form if the soil is worked early in spring when it is too wet. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides.

This soil has poor potential for building site development because of the wetness and the flooding. Artificial

drainage and, in most places, protection against flooding are needed. Dwellings and small buildings are most suitable if they are constructed without basements. Foundations and footings of unheated buildings should be designed to prevent the structural damage caused by frost action. Shallow excavations are difficult because the underlying sand is wet. Excavations are easiest when the water table is below the depth of excavation.

This soil is poorly suited to septic tank absorption fields because it is wet and because the water in shallow wells and in streams can be contaminated by effluent that seeps into the rapidly permeable underlying sand. If drainage is provided and the upper layers are replaced or covered with base material, this soil is suitable as a site for local roads. It is a fair to good source of roadfill. Capability subclass IIw; not assigned to a range site.

276—Oldham silty clay loam. This nearly level, very poorly drained, calcareous soil is in drained depressions on the lake plain and in the drained basins of shallow lakes and ponds on glacial uplands. It is subject to flooding. In most areas fragments of snail shells and clam shells are on the surface and in the soil. Individual areas range from 5 to 75 acres in size.

Typically, the surface layer is black silty clay loam about 13 inches thick. The subsoil is very dark gray, friable silty clay loam about 18 inches thick. It contains many gypsum crystals in the upper part. The underlying material to a depth of 60 inches is lake-laid sediments of dark gray and gray, mottled silty clay loam. In some areas the soil has layers that range from silty clay and silt loam to clay loam and loam. In a few places the thickness of the dark colored surface layer combined with that of the subsoil is less than 24 inches. The soil is calcareous throughout.

Included with this soil in mapping are small areas where the surface layer and subsoil are not calcareous and are similar to those of Quam or Glencoe soils. Also included are Vallers or Canisteo soils on narrow rims and in some sandy beach areas. Included soils make up 5 to 25 percent of some areas.

Permeability is moderately slow or slow, available water capacity is high, and surface runoff is very slow or ponded. The soil is mildly alkaline to moderately alkaline, and some layers have a high content of lime and gypsum. The content of organic matter is high, the content of phosphorus is very low, and the content of potassium is high. The water table is usually at or near the surface in undrained areas, but during long dry periods it is lower.

Most areas are cropped. Some areas where more drainage is needed are used for grazing or wild hay. This soil has good to fair potential for cultivated crops, hay crops, and range. It has good potential for wetland wildlife habitat if it is partly drained. It has poor potential for windbreaks and for most engineering uses.

If adequately drained and fertilized and properly managed, this soil is suited to all of the crops commonly grown in the county. Wetness is the main limitation. Excess lime in the surface layer causes problems in maintaining fertility. Soil blowing occurs in places. Crops are subject to frost and, as a result, a variety of corn that matures early is desirable. Tile is needed to provide subsurface drainage. In places the ground water contains enough magnesium sulfate to cause disintegration of ordinary cement tile. Clay tile or alkali-resistant tile should be used. Fall plowing permits rapid preparation of a seedbed in spring. If fall-plowed fields are left rough and some residue is left on the surface, soil blowing can be controlled. If this soil is worked when too wet, hard clods that are difficult to break form. If crop growth is poor after adequate drainage, a liberal amount of potassium and phosphorus is needed in fertilizers. These nutrients help to correct the fertility imbalance caused by the high content of lime. An occasional sod or green manure crop helps to maintain good tilth in the surface layer.

The potential of this soil for the trees and shrubs needed in windbreaks is poor. The wetness and the high content of lime reduce the number of species that can grow well. The excessive lime interferes with the uptake of nutrients in many woody plants. Chlorosis, which is generally caused by a deficiency of available iron, occurs in many trees and shrubs on soils that have a high content of lime. This condition is best controlled by planting trees and shrubs that can tolerate the lime content. Surface water must be removed or kept from accumulating on the soil before trees can be safely planted. Preparation should be completed the fall before planting because clods can form in many years if the soil is worked early in spring when it is too wet. Weeds and grasses in newly established windbreaks can be controlled by shallow cultivation or approved herbicides.

This soil has poor potential for most engineering uses because of the wetness, the flooding, the slow permeability, the susceptibility to frost action, and the shrinking and swelling. The wetness and the flood hazard can be partly overcome by open drainage ditches or drainage tile. Septic tank absorption fields are poorly suited. Adequately designed road ditches that remove surface water and a cover of suitable base material are needed if local roads and streets are to function properly. Capability subclass IIIw; Wetland range site.

284B—Poinsett silty clay loam, 1 to 4 percent slopes. This very gently sloping, well drained soil is on hilltops that were formerly parts of ice-walled lake plains. Typically, no stones are on the surface or in the soil, but in places a few pebbles and stones are on the surface. Slopes are simple, slightly convex, and about 125 to 200 feet long. Individual areas range from 3 to 20 acres in size.

Typically, the surface layer is black silty clay loam about 11 inches thick. The subsoil is about 31 inches thick. The upper part is very dark brown, dark grayish brown, and dark yellowish brown, friable silty clay loam; the next part is olive brown, friable silty clay loam; and the lower part is light olive brown, calcareous, friable silt loam. The underlying material to a depth of about 60 inches is lake-deposited sediments of grayish brown, calcareous silty clay loam. Small sandy beaches and sand bars are in a few places on ice-walled lake plains.

Included with this soil in mapping are small areas of the more sloping, eroded Poinsett soils and of Barnes and Sinai soils. These soils make up 5 to 20 percent of the unit. The eroded Poinsett soils are on the complex parts of side slopes. The well drained Barnes soils are in areas where glacial till has been exposed or the silt mantle is thin. The moderately well drained, nearly level Sinai soils are in slightly concave spots where clayey lake-laid sediments are evident.

Permeability is moderate, surface runoff is medium, and available water capacity is high. In most places reaction in the surface layer is neutral. The content of organic matter and potassium is high, and the content of phosphorus is low. The seasonal high water table is at a depth of more than 6 feet.

Most areas are cropped. This soil has good potential for cultivated crops, hay, and windbreaks. It has good or fair potential for most engineering uses.

This soil is suited to all of the crops commonly grown in the county. The hazard of erosion is slight. Some areas are well suited to terracing and contour farming. Minimum tillage practices, such as chisel plowing, help to control erosion. Leaving crop residue on the surface and keeping the surface rough reduce the risk of soil blowing on fall-plowed fields during winter and spring. An occasional green manure or sod crop helps to maintain good structure and tilth. Grassed waterways are needed in areas where water collects on and crosses this soil.

This soil is well suited to the trees and shrubs needed in windbreaks. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides. Soil blowing and water erosion can be controlled by maintaining crop residue on the surface. If the site for a windbreak is in sod, plowing and disking during the summer or fall before planting increase the moisture supply and kill unwanted vegetation.

This soil has good potential for septic tank absorption fields. The moderate permeability is a limitation, but it can be easily overcome by increasing the size of the absorption area. The hazard of frost heave and the shrinking and swelling can be partly overcome on sites for roads and dwellings without basements by providing good surface drainage and a cover of suitable base material. Capability subclass IIe; Silty range site.

284B2—Poinsett silty clay loam, 3 to 6 percent slopes, eroded. This gently sloping, well drained soil is on hilltops and hillsides that were formerly parts of ice-walled lake plains. Typically, no stones are on the surface or in the soil, but a few stones and pebbles are on the surface in places. Slopes are simple, convex, and about 150 to 200 feet long. Individual areas range from 3 to 50 acres in size.

Typically, the surface layer is very dark gray silty clay loam about 9 inches thick. The subsoil is about 27 inches thick. The upper part is very dark brown, dark grayish brown, and dark yellowish brown, friable silty clay loam; the next part is olive brown, friable silty clay loam; and the lower part is light olive brown, calcareous friable silt loam. The underlying material to a depth of about 60 inches is lake-deposited sediments of grayish brown, calcareous silty clay loam. Some small sandy beaches and sand bars are in a few places on ice-walled lake plains.

Included with this soil in mapping are small areas of Sinai and Barnes soils. These soils make up 5 to 15 percent of the unit. The moderately well drained, gently sloping Sinai soils are in slightly concave spots where clayey lake-laid sediments are evident. The well drained Barnes soils are in areas where glacial till is exposed or the silt mantle is thin.

Permeability is moderate, surface runoff is medium, and available water capacity is high. In most places reaction in the surface layer is neutral. The content of organic matter is moderate or high, the content of phosphorus is low, and the content of potassium is high. The seasonal high water table is at a depth of more than 6 feet.

Most areas are cropped. This soil has good potential for cultivated crops, range, and windbreaks. It has good or fair potential for most engineering uses.

This soil is suited to all of the crops commonly grown in the county. The hazard of erosion is moderate. The long, smooth slopes are suited to contouring and terracing. Minimum tillage practices, such as chisel plowing, also help to control erosion, particularly in areas that are not suited to contouring. Leaving crop residue on the surface and keeping the surface rough reduce the risk of soil blowing on fall-plowed fields during winter and spring. An occasional green manure or sod crop helps to maintain good structure and tilth. Grassed waterways are needed in areas where water collects on and crosses this soil.

This soil is suited to the trees and shrubs needed in windbreaks. Erosion can be controlled by maintaining mulch or crop residue on the surface. In places windbreaks can be planted on the contour. Weeds can be controlled in newly established windbreaks by shallow cultivation or approved herbicides. If the site for a windbreak is in sod, plowing and disking during the summer or fall before planting increase the moisture supply and kill unwanted vegetation.

This soil has good potential for septic tank absorption fields. The moderate permeability, a limitation, can be easily overcome by increasing the size of the absorption area. If dwellings without basements are constructed on this soil, good drainage around the buildings and a blanket of suitable material below the foundation and floor are needed to overcome the hazard of frost heave and the shrinking and swelling. If local roads and streets are to function properly, a cover of suitable base material is needed. Capability subclass IIe; Silty range site.

284C2—Poinsett silty clay loam, 6 to 12 percent slopes, eroded. This sloping, well drained soil is on the steepest, most convex parts of ice-walled lake plains. Slopes are simple, convex, and 150 to 200 feet long. Individual areas range from 3 to 25 acres in size.

Typically, the surface layer is very dark grayish brown silty clay loam about 8 inches thick. The subsoil is friable silty clay loam about 19 inches thick. It is olive brown in

the upper part and light olive brown and grayish brown in the lower part. The underlying material to a depth of about 60 inches is lake-deposited sediments of grayish brown, mottled silty clay loam. The soil is calcareous throughout. On the upper and lower parts of side slopes are areas where the surface layer is darker and the surface layer and subsoil are leached of free lime.

Included with this soil in mapping are a few areas, on side slopes, of Barnes and Buse soils, which are loam glacial till. These included areas make up 5 to 15 percent of the unit. Also included is a small acreage of moderately steep Poinsett soils.

Permeability is moderate, available water capacity is high, and surface runoff is rapid. Typically, the surface layer is neutral, but in eroded areas it is mildly alkaline. The content of organic matter is low to moderate. The content of phosphorus is low, and that of the potassium is medium. The seasonal high water table is at a depth of more than 6 feet.

Most areas are cropped. The steeper areas are used for grazing. This soil has fair potential for cultivated crops and good potential for hay crops and range. It has fair or good potential for windbreaks and fair potential for most engineering uses.

If erosion is controlled and fertility maintained, this soil is well suited to the crops commonly grown in the county. The hazard of further erosion is severe. Grassed waterways are needed in areas where water collects. If slopes are not suitable for terracing and contouring, a high level of management and a crop rotation that includes a meadow crop are needed to control runoff and erosion. A high level of management includes spring plowing, heavy applications of manure, return of all crop residue to the soil, and disking instead of plowing for the small grain crop that follows corn in the rotation.

This soil is suited to the trees and shrubs needed in windbreaks. Trees and shrubs planted in severely eroded areas have higher mortality and grow more slowly because of low fertility and excessive lime. Erosion can be controlled by planting on the contour or by maintaining a mulch of crop residue. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides. If the site for a windbreak is in sod, plowing and disking during the summer or fall before planting increase the moisture supply and kill unwanted vegetation.

Erosion is a concern if this soil is used for most engineering purposes. It can be controlled on the shoulders and sides of roads by seeding, mulching, and sodding. If dwellings are located on the less sloping foot slopes or ridgetops, erosion is more easily controlled. The hazard of frost heave and the shrinking and swelling can be partly overcome on sites for roads and dwellings without basements by providing good surface drainage and by using material that is less susceptible to frost heave and to shrinking and swelling in the base. Frost heave generally is not a problem if the buildings are heated. The moderate permeability, a limitation in septic tank absorption fields, can be overcome by increasing the size of the absorption area. Capability subclass IIIe; Silty range site.

335—Urness silt loam. This nearly level, very poorly drained soil is in drained lake basins and ponds. It is subject to flooding. The lake basins typically have escarpments along their sides. Fragments of snail shells and clam shells are on the surface and in the soil. Individual areas range from 10 to more than 200 acres in size.

Typically, the highly organic surface layer is about 44 inches thick. It is black silt loam in the upper part; very dark gray, mottled silt loam in the next part; and very dark gray, mottled silty clay loam in the lower part. The underlying material to a depth of about 60 inches is lake deposits of olive, mottled silty clay loam. These lake deposits are underlain by loam or clay loam glacial till. The soil is calcareous throughout.

Included with this soil in mapping are areas of Canisteo and Vallers soils on islands, peninsulas, and borders. These soils formed in glacial till. Also included are lake beaches along the borders, sand bars that extend into the former lake basin, and areas of Oldham soils in some lake basins. These Oldham soils are more clayey than the Urness soil. Included areas make up 5 to 10 percent of the unit.

Permeability is moderate or moderately slow, and available water capacity is very high. The surface layer is mildly alkaline or moderately alkaline because the content of lime and of snail fragments and clam shells is high. The content of organic matter is very high, that of phosphorus is medium, and that of potassium is very high. The seasonal high water table is at or near the surface in areas that have been only partly drained by surface ditches and drainage tile.

Most areas are cropped. Some partly drained areas are used for grazing or wild hay. This soil has good potential for cultivated crops, fair potential for range, fair to poor potential for windbreaks, and good potential for wetland wildlife habitat. It has poor potential for most engineering uses.

This soil is suited to corn, soybeans, and small grain if it is adequately drained and fertilized. Wetness is the main limitation. Excess lime in the surface layer causes problems in maintaining fertility. Soil blowing occurs in large open areas. Crops are subject to frost, and, as a result, a variety of corn that matures early is desirable. Tile is needed to provide subsurface drainage. In places the soil contains enough magnesium sulfate to disintegrate ordinary cement tile. Clay tile or alkali-resistant cement tile should be used. Fall plowing permits rapid preparation of a seedbed in spring. If fall-plowed fields are left rough and some residue is left on the surface, soil blowing can be controlled. If this soil is worked when too wet, hard clods that are difficult to break form. If crop growth is poor after adequate drainage has been provided, a liberal amount of potassium and phosphorus is needed in fertilizers. These nutrients correct the fertility imbalance caused by the high content of lime.

The potential of this soil for the trees and shrubs needed in windbreaks is fair to poor. The wetness and the high content of lime reduce the number of species that can grow well. The excessive lime interferes with the uptake of nutrients in many woody plants. Chlorosis, which is generally caused by a deficiency of available iron, occurs in many trees and shrubs on soils that have a high content of lime. This condition is best controlled by planting trees and shrubs that can tolerate the lime content. Surface water must be removed or kept from accumulating on the soil before trees can be safely planted. Site preparation should be completed the fall before planting because in many years clods form if the soil is worked early in spring when it is too wet. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides.

This soil is limited by the high water table, the flooding, the high susceptibility to frost action, and the low strength of the thick, highly organic surface layer. As a result, it has poor potential for most engineering uses. If local roads are constructed across areas of this soil, the highly organic surface layer should be removed and replaced with suitable fill material. Properly designed road ditches are needed to control surface water. Capability subclass IIIw; Wetland range site.

339—Fordville loam, 0 to 2 percent slopes. This nearly level, well drained soil is on river terraces and outwash plains and in gravelly areas on the glaciated uplands and the lowland plains. Most areas in uplands are irregular in shape, whereas areas along river terraces are more uniform in shape. Individual areas range from 3 to 30 acres in size.

Typically, the surface layer is black loam about 12 inches thick. The subsoil is about 16 inches thick. It is dark brown and brown loam in the upper part and dark yellowish brown and pale brown, calcareous loam in the lower part. The underlying material to a depth of about 60 inches is dark yellowish brown, calcareous gravelly coarse sand. In some areas the underlying material is sandy. Wind has eroded a small acreage and has exposed the brownish subsoil in some areas.

Included with this soil in mapping are small acreages where the sandy and gravelly underlying material is only a few feet thick over silty material or glacial till and a few areas on river terraces where the surface layer and subsoil are calcareous. Also included are small areas of the somewhat excessively drained Arvilla soils. These soils are shallow over gravelly underlying material. They make up 2 to 10 percent of the unit.

Permeability is moderate in the surface layer and subsoil and rapid in the underlying sand and gravel. Surface runoff is slow. Available water capacity is moderate. The surface layer is neutral or slightly acid. The content of organic matter is naturally high, the content of phosphorus is very low, and the content of potassium is medium. Roots are restricted by the sand and gravel below a depth of 20 to 40 inches. The seasonal high water table generally is at a depth of more than 6 feet.

Most areas are cropped. If this Fordville soil occurs among more droughty soils, it is commonly used for grazing. It has fair potential for cultivated crops, good to fair potential for range and pasture, and good potential for all engineering uses but those affected by seepage or the caving of cutbanks.

Except for years when there is a long drought, corn, soybeans, small grain, and alfalfa are fairly well suited. Drought is the major hazard. This soil is subject to soil blowing, especially after fall plowing. Leaving crop residue on the surface during winter helps to hold snow and to provide moisture for the next crop. The surface layer can be easily worked into a good seedbed. The main management needs are increasing fertility, maintaining organic-matter content, and increasing available water capacity. Grassed waterways in the drainageways that cross this soil generally prevent gullying into the coarse-textured underlying material. This soil is well suited to irrigation. It can be row cropped intensively if water for irrigation is available.

The potential of this soil for the trees and shrubs needed in windbreaks is fair. Available water capacity is moderate, and many trees and shrubs are likely to die if drought occurs while they are becoming established. The mortality rate can be partly overcome by providing special care in site preparation and in planting and by weed control. In exposed areas where the soil is intermingled with sandy soils, soil blowing is a hazard to young trees and shrubs. It can be controlled by maintaining a mulch of crop residue. Competition for moisture generally is critical. Weeds and grasses can be controlled by shallow cultivation or approved herbicides.

This soil is suitable for building site developments. Septic tank absorption fields work well, but contamination of underground water is a hazard because of seepage and rapid permeability. The pollution hazard limits the use of this soil for sanitary landfills. Cutbanks in shallow excavations can cave, but this limitation can be overcome by providing retaining walls or by enlarging the excavation. Some areas are good sources of gravel. The upper layer of the soil should be removed or strengthened with suitable base material if local roads and streets are to function properly. Capability subclass IIs; Silty range site.

339B—Fordville loam, 2 to 6 percent slopes. This well drained soil is on stream terraces, on outwash plains, and, in a few areas, on the glaciated uplands and the lowland plains. On stream terraces and outwash plains, slopes are gently sloping, convex, and single. On uplands, they are undulating, convex, and complex. Individual areas range from 3 to 25 acres in size.

Typically, the surface layer is black loam about 10 inches thick. The subsoil is about 16 inches thick. It is dark brown and brown, hard to friable loam in the upper part and dark yellowish brown and pale brown, calcareous, hard to friable loam in the lower part. The underlying material to a depth of about 60 inches is dark yellowish brown, calcareous gravelly coarse sand. In places, the surface layer is 6 to 8 inches thick and tillage has

mixed part of the subsoil into the surface layer after erosion has occurred. In a few areas the underlying material is fine and medium sand.

Included with this soil in mapping are small areas of more sloping Fordville soils and some areas where the sandy and gravelly underlying material is only a few feet thick over silty alluvium or glacial till. Also included are small areas of Arvilla soils, which have low available water capacity. These soils are on the more exposed parts of side slopes and are shallow over gravelly underlying material. They make up 2 to 10 percent of the unit.

Permeability is moderate in the surface layer and subsoil and rapid in the underlying sand and gravel. Surface runoff is medium, and available water capacity is moderate. The surface layer is neutral or slightly acid. The content of organic matter is high, the content of phosphorus is very low, and the content of potassium is medium. Depth to the gravelly underlying material typically is 22 to 28 inches, but it ranges from 20 to 40 inches. The seasonal high water table is at a depth of more than 6 feet.

Most areas are cropped or used for grazing. This soil has fair potential for cultivated crops and windbreaks and good to fair potential for range and pasture. It has good potential for all engineering uses but those affected by seepage or the caving of cutbanks.

Small grain, soybeans, and alfalfa are the best suited crops. Corn is less well suited. The major concerns of management are the moderate hazard of erosion and the moderate available water capacity. A good seedbed is easy to prepare. The hazards of soil blowing and water erosion can be reduced by spring plowing. Leaving stubble and corn stalks on the surface during winter holds snow and helps to provide moisture for the next crop. Grassed waterways help to prevent the formation of gullies that can cut into the sand and gravel.

The potential of this soil for the trees and shrubs needed in windbreaks is fair. Available water capacity is moderate, and many trees and shrubs are likely to die if drought occurs. The mortality rate can be partly overcome by providing special care in site preparation and in planting and by weed control. In some exposed areas where this soil is intermingled with sandy soils, soil blowing is a hazard to young trees or shrubs. Soil blowing and water erosion can be controlled by maintaining a cover of crop residue. Competition for moisture generally is critical. Weeds and grasses can be controlled by shallow cultivation or approved herbicides.

This soil is suitable for building site developments. Septic tank absorption fields work well, but contamination of underground water and streams is a hazard because of seepage and rapid permeability. The pollution hazard limits the use of this soil for sanitary landfills. Cutbanks in shallow excavations can cave, but this limitation can be overcome by providing retaining walls or by enlarging the excavation. Some sites are a good source of gravel for roadfill. The upper layers of the soil should be removed or strengthened with suitable base material if local roads and streets are to function properly. Capability subclass IIe; Silty range site.

341—Arvilla sandy loam, 0 to 2 percent slopes. This somewhat excessively drained, nearly level soil is dominantly on river terraces and outwash plains. A few areas are in the glaciated uplands or on the lowland plains. Most areas are irregular in shape and range from 3 to 60 acres in size.

Typically, the surface layer is black sandy loam about 9 inches thick. The subsoil is about 10 inches thick. It is very dark grayish brown, friable sandy loam in the upper part and dark brown, very friable coarse sandy loam in the lower part. The underlying material to a depth of about 60 inches is dark yellowish brown and brown, calcareous gravelly loamy coarse sand (fig. 9). The brownish subsoil is exposed in some areas.

Included with this soil in mapping is a small acreage where the gravel deposits are only a few feet thick over glacial till or silty alluvium. Also included are small areas of Sioux and Fordville soils, which make up 3 to 10 percent of the unit. The excessively drained Sioux soils are in old stream meanders and on escarpments. They are more shallow over gravel than this Arvilla soil. The well drained Fordville soils are in slightly concave areas. They are less sandy than the Arvilla soil and are deeper over gravel.

Permeability is moderately rapid in the surface layer and subsoil and rapid in the underlying gravelly sand. Surface runoff is slow. Available water capacity is low. The surface layer typically is neutral but is alkaline in a few areas. The content of organic matter is moderate or high, the content of phosphorus is very low, and the content of potassium is low or medium. Roots are restricted by underlying gravelly sand at a depth of 15 to 22 inches. The seasonal high water table is at a depth of more than 6 feet.

Most areas are cropped or are used for grazing. This soil has fair to poor potential for cultivated crops, good potential for irrigated crops, and fair potential for hay crops, range, and windbreaks. It has good potential for all engineering uses but those affected by seepage and the caving of cutbanks.

If an adequate amount of fertilizer is applied and all crop residue is returned to the soil, row crops can be grown. Corn grows well, but only in years when rainfall is both adequate and timely. Optimum growth is assured if water for irrigation is available. Small grain and hay crops are more reliable. Drought is the main limitation, but soil blowing can be a serious hazard, especially in spring. Spring plowing reduces the risk of soil blowing. Leaving stubble and stalks on the surface during winter helps to trap snow and conserves moisture. Minimum tillage practices, such as chisel plowing, reduce the risk of soil blowing and moisture loss. A single-row shelterbelt reduces the risk of soil blowing and the loss of moisture through evaporation and transpiration. Wind stripcropping, in which close growing crops and intertilled crops are grown in alternate narrow bands, also reduces loss of soil and moisture.

This soil is not well suited to many tree and shrub species. Many trees are likely to die if drought occurs while they are becoming established. The mortality rate can be partly overcome by providing special care in site preparation and in planting and by weed control. Trees on this soil generally grow slowly and are commonly stunted. Also, they tend to have a shorter life than the same species on soils that are underlain by finer textured material. Field windbreaks are effective in controlling soil blowing, but care is needed to keep young trees or shrubs from being damaged by windblown particles of soil. A cover of grass or of crop residue from corn or small grain reduces the risk of soil blowing.

This soil is suitable for building site developments, local roads and streets, and roadfill. Septic tank absorption fields work well, but contamination of underground water is a hazard because of seepage and rapid permeability. The pollution hazard limits the use of this soil for sanitary landfills. Cutbanks in shallow excavations can cave, but providing retaining walls or enlarging the excavation can overcome this limitation. Gravel pits are in some areas of this soil. Capability subclass IIIs; Shallow to Gravel range site.

341B—Arvilla sandy loam, 2 to 6 percent slopes. This somewhat excessively drained soil is gently sloping on stream terraces and outwash plains and undulating on the glaciated uplands and the lowland plain. The surface is stony in some areas. Most areas are irregular in shape and range from 3 to 100 acres in size.

Typically, the surface layer is black sandy loam about 9 inches thick. The subsoil is about 10 inches thick. It is very dark grayish brown, friable sandy loam in the upper part and dark brown, very friable coarse sandy loam in the lower part. The underlying material to a depth of about 60 inches is dark yellowish brown and brown, calcareous gravelly loamy coarse sand. In cultivated areas the surface layer is about 6 inches thick and is somewhat lighter in color as a result of erosion and loss of organic matter. In some small areas the brownish subsoil is exposed.

Included with this soil in mapping is a small acreage where the gravel deposits are only a few feet thick over glacial till or silty alluvium. Also included are spots of Sioux and Fordville soils, which make up 5 to 10 percent of the unit. The excessively drained Sioux soils are on exposed knobs and escarpments. They are more shallow over gravel than this Arvilla soil. The well drained Fordville soils are in slightly concave spots and in drainageways. They have a less sandy solum than the Arvilla soil and are deeper over gravel.

Permeability is moderately rapid in the surface layer and subsoil and rapid in the underlying gravelly sand. Surface runoff is slow to medium. Available water capacity is low. The surface layer typically is neutral, but in a few areas it is alkaline. The content of organic matter is moderate or high, the content of phosphorus is very low, and the content of potassium is low or medium. Roots are restricted by the underlying gravelly sand at a depth of 14 to 20 inches. The seasonal high water table is at a depth of more than 6 feet.

Most areas are cropped or are used for grazing. This soil has fair to poor potential for cultivated crops, range, hay crops, and windbreaks. It has good potential for all engineering uses but those affected by seepage and the caving of cutbanks.

Small grain and meadow crops are fairly well suited to this soil. Except for years when the rainfall is both adequate and timely, the soil is too droughty for corn. If a meadow crop, which tends to use up soil moisture, is grown more than 1 year in a rotation, the amount of moisture is insufficient for the corn or small grain during the next year. As a result of low available water capacity, droughtiness is a limitation. Also, erosion is a hazard. Minimizing tillage and returning all crop residue to the soil help to control erosion and conserve moisture in areas where slopes are too irregular for contouring. Spring plowing also helps to control soil blowing and erosion, particularily soil blowing. Leaving stubble on the surface during winter helps to trap snow and conserves moisture. A single-row shelterbelt also helps to control erosion and conserves moisture.

This soil is not well suited to many species of trees and shrubs. Many trees are likely to die if drought occurs while they are becoming established. The mortality rate can be partly overcome by providing special care in site preparation and in planting and by weed control. Trees on this soil generally grow slowly and are stunted. Also, they tend to have a shorter life than the same species on soils that are underlain by finer textured material. Field windbreaks are effective in controlling soil blowing, but care is needed to keep young trees and shrubs from being damaged by windblown particles of soil. A cover of grass or of crop residue from corn or small grain reduces the risk of soil blowing.

This soil is suitable for building site development, local roads and streets, and roadfill. Septic tank absorption fields work well, but contamination of underground water is a hazard because of seepage and rapid permeability. The pollution hazard limits the use of this soil for sanitary landfills. Cutbanks in shallow excavations can cave, but this limitation can be overcome by providing retaining walls or by enlarging the excavation. Gravel pits are in some areas of this soil. Capability subclass IIIe; Shallow to Gravel range site.

341C—Arvilla sandy loam, 6 to 12 percent slopes. This sloping, somewhat excessively drained soil is on gravelly glaciated uplands and terrace escarpments. A few stones are on the surface and in the soil. Slopes are less than 125 feet long and are convex. Individual areas range from 3 to 15 acres in size.

Typically, the surface layer is black sandy loam about 8 inches thick. The subsoil is about 8 inches thick. It is very dark grayish brown, friable sandy loam in the upper part and dark brown, very friable coarse sandy loam in the lower part. The underlying material to a depth of about 60 inches is dark yellowish brown and brown, calcareous

gravelly loamy coarse sand. The surface layer in cultivated areas generally is lighter in color and thinner. On a small acreage, the soil is underlain by medium sand.

Included with this soil in mapping is a small acreage where the gravel deposits are only a few feet thick over glacial till or silty alluvium. Also included are spots of the excessively drained Sioux soils, which make up 5 to 15 percent of the unit. These soils are on the most exposed knobs and parts of side slopes and have gravel and cobbles on the surface.

Permeability is moderately rapid in the surface layer and subsoil and rapid in the underlying gravelly sand. Surface runoff is medium, and available water capacity is low. The surface layer typically is neutral, but in some areas it is alkaline. The content of organic matter ranges from moderate to high, the content of phosphorus is very low, and the content of potassium is low or medium. Roots are restricted by the underlying gravelly sand at a depth of 14 to 18 inches. The seasonal high water table is at a depth of more than 6 feet.

Most areas are used for grazing or are cropped. This soil has poor potential for cultivated crops and windbreaks and fair to poor potential for range and hay crops. It has fair potential for all engineering uses but those affected by seepage and the caving of cutbanks.

Most areas that have been cultivated are too droughty for corn. Hay and small grain are better suited crops. As a result of the low available water capacity, drought is the major hazard. Also, erosion is a severe hazard. Spring plowing, heavy applications of manure, and return of all crop residue to the soil are needed. Terraces generally are not built on this soil because it is too shallow over gravelly sand. Waterways should be maintained, and some should be reestablished. In waterways where erosion has exposed the gravelly sand, replacing the top layer promotes the growth of grass. Gullies should be shaped and seeded to form grassed waterways.

This soil is not well suited to many species of trees and shrubs. The mortality in windbreaks is likely to be severe if drought occurs while the trees and shrubs are becoming established. It can be partly overcome by providing special care in site preparation and planting and by weed control. Trees on this soil generally grow slowly and are stunted. Also, they tend to have a shorter life than the same species on soils that are underlain by finer textured material. Field windbreaks are effective in controlling soil blowing, but care is needed to keep young trees or shrubs from being damaged by windblown particles of soil. A cover of grass or of crop residue from corn or small grain reduces the risk of soil blowing and water erosion.

This soil is a good source of roadfill material. If the soil is used as a site for a building or road, special design and care in selecting the site are needed because of the slope. Septic tank absorption fields are difficult to lay out because of the slope. In addition, contamination of underground water and streams is a hazard because of seepage and rapid permeability. Cutbanks in shallow excavations can cave, but this limitation can be overcome by providing retaining walls or by enlarging the excavation. Capability subclass IVe; Shallow to Gravel range site.

344—Quam silty clay loam. This nearly level, very poorly drained soil is in shallow depressions and very wet drainageways in the glaciated uplands. It is subject to flooding. In most areas no stones are on the surface or in the soil. The depressions are saucer shaped and range from 3 to 40 acres in size.

Typically, the surface layer is black silty clay loam and mucky silt loam about 33 inches thick. The subsoil is very dark gray, mottled, friable silty clay loam about 10 inches thick. The underlying material to a depth of about 60 inches is olive gray, mottled silty clay loam. An overlying layer of muck as much as 15 inches thick is evident in some of the larger depressions. In a few areas the surface layer is clay loam. Generally, the depth to free lime is 4 feet or more, but in some areas free lime is at or near the surface.

Included with this soil in mapping are areas of Vallers soils on the narrow rims of the depressions and some sandy beach areas adjacent to some of the larger depressions. These included areas make up 3 to 10 percent of the unit. Also included, in depressions near areas of the clayey Fulda soils, is a small acreage of soils that formed in sediments of silty clay and clay and are more slowly permeable than the typical Quam soil.

Permeability is moderately slow, and available water capacity is high. Surface runoff is very slow, and in places water ponds. In most places reaction in the surface layer is neutral. The content of organic matter and potassium is high, and the content of phosphorus is medium or low. In undrained areas the water table is at or near the surface in spring and during wet periods.

Most areas are drained and are cropped. This soil has good potential for cultivated crops and hay crops and fair potential for windbreaks. Inadequately drained areas have fair to good potential for range. Undrained areas are marshy and have good potential for wetland wildlife habitat. Most areas have poor potential for engineering uses.

If drained, this soil is well suited to all of the crops commonly grown in the county. The major limitation is wetness. Management that reduces compaction and maintains good tilth is needed. Tile is needed to provide subsurface drainage, but it does not function so well in areas near the Fulda soils. Open ditches can drain away surface water and in places can provide outlets for tile drains. Fall plowing permits rapid preparation of a seedbed in spring. If fall-plowed fields are left rough and some residue is left on the surface, soil blowing can be controlled. If this soil is worked when too wet, hard clods that are difficult to break form. An occasional sod or green manure crop helps to maintain good tilth in the surface layer.

Unless surface water is a problem, this soil has fair potential for the trees and shrubs needed in windbreaks. If adequate subsurface drainage is provided, more species of trees and shrubs can be grown successfully. Site

preparation should be completed the fall before planting because in many years clods form if the soil is worked early in spring when it is too wet. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides.

Because of the wetness, the flood hazard, the susceptibility to frost action, and the shrinking and swelling, this soil is poorly suited to most engineering uses. The wetness and the flood hazard can be partly overcome by open drainage ditches or drainage tile. Onsite investigation is needed to determine the best method for a particular area. Septic tank absorption fields are poorly suited because of the wetness and the moderately slow permeability. Capability subclass IIIw; Wetland range site.

345—Wilmonton clay loam, 0 to 2 percent slopes. This nearly level, moderately well drained soil is in broad, flat areas or in long, narrow areas adjacent to drainageways on glaciated uplands. Slopes are plane or slightly concave. Individual areas range from 5 to several hundred acres in size.

Typically, the surface layer is black clay loam about 18 inches thick. The subsoil is dark grayish brown, firm clay loam about 13 inches thick. Very dark gray worm casts are common in the upper part, and olive brown mottles are in the lower part. The underlying material to a depth of about 60 inches is dark grayish brown and light olive brown, mottled, calcareous clay loam glacial till. In a few places the surface layer is more than 24 inches thick, and in some places it is less than 12 inches thick.

Included with this soil in mapping are small areas of Letri, Everly, and Glencoe soils. These soils make up 5 to 15 percent of the unit. The poorly drained Letri soils are in shallow drainageways, the well drained Everly soils are gently undulating on knolls and nearly level in areas above deep drainageways, and the very poorly drained Glencoe soils are in shallow depressions.

Permeability is moderately slow, and available water capacity is high. Surface runoff is medium to slow. The surface layer is neutral or slightly acid. It is naturally high in content of organic matter, low in content of phosphorus, and high in content of potassium. The seasonal high water table is at a depth of 3 to 6 feet.

Most areas are cropped. This soil has good potential for cultivated crops, hay, pasture, and windbreaks. It has fair potential for most engineering uses.

This soil is well suited to all of the crops commonly grown in the county. It has few limitations, and it can be cropped intensively. This moderately well drained soil does not dry out so quickly in spring as the nearby well drained Everly soil and cannot be worked so early. Leaving crop residue on the surface of fall-plowed fields helps to control soil blowing. An occasional green manure or sod crop helps to maintain good structure and tilth.

This soil has few characteristics detrimental to the growth and survival of trees in windbreaks. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides. The hazard of seedling mortality is moderate because the soil is somewhat clayey. This hazard can be reduced by not working the soil or planting the seedlings under wet conditions. If the site for a windbreak is in sod, plowing and disking during the summer or fall before planting increase the moisture supply and kill unwanted vegetation.

The seasonal high water table moderately limits most engineering uses. This soil is suitable as a septic tank absorption field in areas where the seasonal high water is below a depth of 4 feet. The moderately slow permeability can be overcome by increasing the size of the absorption area. The water table can be controlled on sites for dwellings with basements by installing tile around the footings. Unheated buildings without basements are less affected by the water table but are highly susceptible to frost action. The susceptibility to frost action can be overcome by providing good surface drainage and a base of more suitable material.

A cover of suitable base material also is needed to control the hazard of frost action on local roads and streets. If used as roadfill, the underlying material is suitable in the subgrade, but material that is stronger and less susceptible to frost action is needed in the base. In most areas of the included soils, the seasonal high water table is shallower than that in the Wilmonton soil. As a result, these soils are less suitable for most engineering uses. Capability class I; not assigned to a range site.

347—Malachy loam. This nearly level, moderately well drained and somewhat poorly drained, calcareous soil is on former streambeds, beaches, and sand bars on the lake plain. Slopes are slightly convex. Individual areas range from 5 to 100 acres in size.

Typically, the surface layer is loam about 15 inches thick. It is black in the upper part and very dark gray and dark grayish brown in the lower part. The subsoil is about 21 inches thick. It is dark grayish brown, mottled, and friable. The upper part is loam, and the lower part is fine sandy loam. The underlying material to a depth of about 60 inches is pale brown and light yellowish brown sand. All parts of the soil below a depth of about 8 inches contain free lime. In some areas the surface layer is more than 16 inches thick. These areas are good sources of topsoil. In places, the surface layer is completely leached of free lime or free lime is at the surface. In some areas, thin bands of silty material are in the sandy underlying material at a depth of 20 to 40 inches or the underlying material is silty glacial till at a depth of 40 to 60 inches. Available water capacity is higher than that in this Malachy soil, and these areas are therefore more resistant to drought.

Included with this soil in mapping are spots of Sverdrup, Sioux, and Arvilla soils. These soils make up 3 to 10 percent of the unit. They are shallow over sand and gravel. Crops on these soils are the first to wilt during midsummer dry periods.

Permeability is moderately rapid above the sandy underlying material. Surface runoff is medium to slow, and available water capacity is moderate. The surface layer is mildly alkaline. The content of organic matter is high, the

content of phosphorus is very low, and the content of potassium is medium. In most areas sand or sand and gravel at a depth of 20 to 40 inches restrict the root zone. The seasonal high water table is at a depth of 3 to 5 feet.

Most areas are cropped. This soil has fair potential for cultivated crops, hay, pasture, windbreaks, and most engineering uses.

Except for years when a long drought occurs, corn, soybeans, small grain, and alfalfa are fairly well suited. Drought is the major hazard. The soil is subject to soil blowing, especially after fall plowing. A single-row shelterbelt reduces the risk of soil blowing and the loss of moisture through evaporation and transpiration. The main management needs are increasing fertility, maintaining organic-matter content, and increasing available water capacity. Leaving crop residue on the surface helps to hold soil moisture and provides moisture for the next crop. The surface layer is easy to work and can be made into a good seedbed.

The potential of this soil for the trees and shrubs needed in windbreaks is fair. Available water capacity is moderate, and many trees and shrubs are likely to die if drought occurs while they are becoming established. The mortality rate can be partly overcome by providing special care in site preparation and in planting and by weed control. In some exposed areas where the surface layer is sandy loam, soil blowing is a hazard to young trees and shrubs. It can be controlled by maintaining a cover of crop residue. Competition for moisture generally is critical. Weeds and grasses can be controlled by shallow cultivation or approved herbicides.

This soil has fair potential for dwellings without basements and for local roads and steets. The potential frost action can be overcome by providing good surface drainage around the dwellings and along the roads and streets. The water table can be controlled around dwellings with basements by placing drain tile around the footings. The underlying material is suitable as roadfill. The potential for septic tank absorption fields is fair, but contamination of underground water is a hazard because of seepage and rapid permeability. Cutbanks in shallow excavations can cave, but this limitation can be overcome by providing retaining walls or by enlarging the excavation. Capability subclass IIs; not assigned to a range site.

402E—Sioux soils, 2 to 40 percent slopes. These undulating to very steep, excessively drained soils are on terrace escarpments and on gravelly ridges in glaciated uplands. Slopes on terrace escarpments are simple, whereas slopes in the uplands are complex. Individual areas range from 3 to 10 acres in size.

Typically, the surface layer is black gravelly sandy loam about 11 inches thick. The underlying material to a depth of about 16 inches is dark grayish brown and dark yellowish brown gravelly coarse sand. Below this to a depth of about 60 inches is dark yellowish brown and grayish brown very gravelly coarse sand. Typically, the soil is calcareous throughout, but in a few places the surface layer is leached of free lime. The surface layer is gravelly loamy coarse sand or gravelly loam in places.

Included with these soils in mapping is a small acreage where the gravelly underlying material is only a few feet thick over glacial till or silty alluvium. Also included are small areas of Arvilla and Fordville soils, which make up 5 to 20 percent of the unit. These included soils are on the less exposed parts of side slopes and escarpments. They are deeper over the gravelly underlying material and are less droughty than the Sioux soils.

Permeability is rapid, and available water capacity is very low or low. These soils take in water rapidly. The surface layer is mildly alkaline. The content of organic matter is moderate or low, the content of phosphorus is very low, and the content of potassium is low. The underlying sand and gravel, which is 7 to 12 inches below the surface, severely restricts the root zone. The seasonal high water table is at a depth of more than 6 feet.

Most areas are used for grazing. These soils have poor potential for cultivated crops and range. They have good to poor potential for engineering uses.

These soils are generally not cropped. In some small areas they are cropped with other, more suitable soils because managing these soils and the more suitable soils separately is not practical. The hazard of drought is very severe because of the very limited available water capacity.

Some areas are used for range. Most of these areas have been overgrazed, and the native grass species have declined in vigor and decreased in abundance. The native grass has been replaced by less productive grasses, mainly Kentucky bluegrass and weeds, such as goldenrod, gumweed, and buckbrush. Proper grazing use, deferred grazing, and a planned grazing system improve the suitability of these soils for range.

The Sioux soils that are undulating and sloping have fair to poor potential for windbreaks. The hazard of seedling mortality is severe during the first year because available water capacity is low or very low and natural fertility is low. This hazard can be reduced by providing special care in site preparation and in planting and by weed control. The moderately steep to very steep Sioux soils generally are very poorly suited to windbreaks. Onsite inspection is needed to determine the suitability of an area for trees and shrubs.

If slopes are gentle, these soils are well suited as sites for dwellings and roads and as sources of roadfill. If slopes are gentle, septic tank absorption fields work well, but contamination of streams and underground water is a hazard because of seepage through the rapidly permeable underlying material. Cutbanks in shallow excavations can cave, but this limitation can be overcome by enlarging the excavation or by providing retaining walls. Gravel pits are in some areas of these soils. Capability subclass VIIs; Very Shallow range site.

418—Lamoure silty clay loam. This nearly level, poorly drained, calcareous soil is on flood plains that are a few feet higher than the rivers, creeks, and drainageways that dissect them. It is occasionally flooded. Individual areas are long and narrow and range from 10 to more than 200 acres in size.

Typically, the surface layer is silty clay loam about 25 inches thick. It is black in the upper part and very dark gray in the lower part. The subsoil is very dark gray, mottled, friable silty clay loam about 13 inches thick. The underlying material to a depth of about 60 inches is mostly dark grayish brown silty clay loam alluvium. The soil is calcareous throughout. In some areas the surface layer is loam or clay loam. Pockets of gypsum are in the subsoil and the underlying material in some areas. In a few areas the calcareous alluvium is covered by 1 foot to 3 feet of noncalcareous, dark colored sediments that have washed in from the uplands. There are likely to be thin sandy layers anywhere in the profile.

Included with this soil in mapping are small areas of La Prairie and Rauville soils. These soils make up 2 to 10 percent of the unit. The moderately well drained La Prairie soils are in slightly raised positions. The very poorly drained Rauville soils are in oxbows and stream channels.

Permeability is moderate, and available water capacity is high. Surface runoff is slow. The surface layer is mildly alkaline. The content of organic matter is high, the content of phosphorus is low, and the content of potassium is high. The seasonal high water table is at a depth of 1 foot to 3 feet.

Most areas are cropped or are used for grazing. This soil has good potential for cultivated crops, hay, pasture, and range. It has fair to poor potential for windbreaks and poor potential for most engineering uses.

This soil is suited to all of the crops commonly grown in the county. The major limitation is wetness. The soil is flooded seasonally, especially by melt water during spring runoff. In places it is also flooded after heavy rains during the growing season, and the floodwater damages crops. In places the surface layer has a high content of lime that causes a fertility imbalance. Drainage tile is difficult to install in most areas, and sufficiently sloping outlets are difficult to establish on bottom land. Dikes that protect the soil from floodwater are practical in places. If the soil is worked when too wet, clods that are difficult to break up form.

The potential of this soil for the trees and shrubs needed in windbreaks is fair to poor. The wetness, the occasional flooding, and the high content of lime reduce the number of species that can grow well. The excessive lime interferes with the uptake of nutrients in many woody plants. Chlorosis, which generally is caused by a deficiency of available iron, occurs in many trees and shrubs on soils that are high in content of lime. This condition is best controlled by planting trees and shrubs that can tolerate the lime content. Site preparation should be completed the fall before planting because in many years clods form if the soil is worked when it is too wet early in spring. Weeds and grasses in newly established windbreaks can be controlled by shallow cultivation or approved herbicides.

Because of the hazard of occasional flooding and the wetness, the potential for dwellings, septic tank absorption fields, and most other engineering uses is poor. Before local roads are constructed across areas of this soil, onsite investigation is needed to determine the extent of flooding and the proper design. Capability subclass IIw; Subirrigated range site.

421B—Ves loam, 1 to 4 percent slopes. This gently undulating, well drained soil is on low hills that rise 5 to 10 feet above the floor of the lowland plain and on the lower parts and tops of hills that have steeper side slopes. Slopes are complex, convex, and about 100 feet long. Individual areas range from 3 to 125 acres in size.

Typically, the surface layer is black and very dark gray loam about 11 inches thick. The subsoil is friable loam about 25 inches thick. The upper part is dark yellowish brown and brown, and the lower part is light olive brown and calcareous. The underlying material to a depth of about 60 inches is olive brown, calcareous loam glacial till. Some spots are sandy and gravelly.

Included with this soil in mapping are small areas of the undulating, eroded Ves soils; Seaforth, Storden, Normania, and Glencoe soils; and poorly drained soils in which the surface layer and subsoil are leached of carbonates. These soils make up 10 to 20 percent of the unit. The moderately well drained, calcareous Seaforth soils are on convex peninsulas at a slightly lower elevation than this Ves soil. The well drained, calcareous Storden soils are on the steepest, most exposed convex parts of hillsides. The moderately well drained Normania soils are in swales, saddles, and other concave areas; the very poorly drained Glencoe soils are in shallow depressions; and the poorly drained, leached soils are in drainageways.

Permeability is moderate, and surface runoff is medium. Available water capacity is high. Reaction in the surface layer is neutral. The content of organic matter is high, the content of phosphorus is low, and the content of potassium is high. The seasonal high water table is at a depth of more than 6 feet.

Most areas are cropped. This soil has good potential for cultivated crops, hay crops, windbreaks, and most engineering uses.

This soil is suited to all of the crops commonly grown in the county. The hazard of erosion is slight. Stones are sometimes pushed to the surface by tillage and by frost action. Tillage is easier if the stones are removed periodically. The short, complex slopes generally are not well suited to terracing and contour farming. Minimum tillage practices, such as chisel plowing, help to control erosion. Leaving crop residue on the surface and keeping the surface rough reduce the risk of soil blowing on fall-plowed fields during winter and spring. An occasional green manure or sod crop helps to maintain good structure and tilth. Grassed waterways are needed in areas where water collects on and crosses this soil.

This soil has few characteristics detrimental to the growth and survival of trees in windbreaks. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides. If the site for a windbreak is in sod, plowing and disking during the

summer or fall before planting increase the moisture supply and kill unwanted vegetation.

This soil is suited to onsite sanitary waste disposal and septic tank absorption fields. In the part of the county where it is mapped, it is the most commonly used soil for absorption fields. It is a good source of topsoil. If used as roadfill, it is suitable as subgrade material, but stronger material that is less susceptible to frost action is better as the base material. Many farmsteads are located on this soil. Most of the included soils have a seasonal high water table within a depth of 6 feet. Depending on depth to the water table, they have moderate or severe limitations for most engineering uses. Capability subclass IIe; not assigned to a range site.

421B2—Ves loam, 3 to 6 percent slopes, eroded. This undulating, well drained soil is on complex, convex hills that rise about 10 feet above the floor of the lowland plain. In spots on eroded hillsides, the yellowish underlying material of Storden soils is exposed. Slopes are 70 to 125 feet long, and areas are 3 to 35 acres in size.

Typically, the surface layer is about 8 inches of very dark gray loam that is mixed with some dark yellowish brown loam. The subsoil is friable loam about 23 inches thick. The upper part is dark yellowish brown and brown, and the lower part is light olive brown and calcareous. The underlying material to about 60 inches is olive brown, calcareous loam glacial till.

Included with this soil in mapping are some sandy and gravelly spots. About 5 to 20 percent of the unit is small included areas of Storden and Normania soils and poorly drained soils in which the surface layer and subsoil are leached of carbonates. The well drained, calcareous Storden soils are on the steepest, most exposed convex parts of hillsides. The moderately well drained Normania soils are in concave areas, such as swales, saddles, and foot slopes. The poorly drained, leached soils are in drainageways.

Permeability is moderate. Surface runoff is medium, and available water capacity is high. Reaction in the surface layer is neutral. The content of organic matter is moderate or high, the content of potassium is naturally high, and the content of phosphorus is low. The seasonal high water table is at a depth of more than 6 feet.

Most areas are cropped. This soil has good potential for cultivated crops, hay crops, windbreaks, and most engineering uses.

This soil is suited to all of the crops commonly grown in the county. The hazard of erosion is moderate. Stones are sometimes pushed to the surface by tillage and by frost action. Tillage is easier if the stones are removed periodically. The complex slopes generally are not well suited to terracing and contour farming. Minimum tillage practices, such as chisel plowing, help to control erosion. Leaving crop residue on the surface and keeping the surface rough reduce the risk of soil blowing on fall-plowed fields during winter and spring. An occasional green manure or sod crop helps to maintain good structure and tilth. Grassed waterways are needed in areas where water collects on and crosses this soil.

This soil is suited to the trees and shrubs needed in windbreaks. If the site for a windbreak is in sod, plowing and disking during the summer or fall before planting increase the moisture supply and kill unwanted vegetation. Erosion can be controlled during site preparation by maintaining crop residue on the surface. In places windbreaks can be planted on the contour. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides.

This soil is suitable as a septic tank absorption field. The underlying material is suitable as roadfill in the subgrade if good drainage is provided along the roadway. Local roads and streets generally are improved if stronger soil material that is less susceptible to frost action is used in the base. Special design or precautions are needed if the small areas of included Normania soils and the included poorly drained, leached soils occur on the construction site. These soils have a more shallow seasonal high water table than the Ves soil. Capability subclass IIe; not assigned to a range site.

423—Seaforth loam, 1 to 3 percent slopes. This nearly level, moderately well drained, calcareous soil is on the low, complex knolls or islands in wet, flat areas and on the low peninsulas on the lowland plain. Individual areas range from 3 to 30 acres in size; most are less than 10 acres.

Typically, the surface layer is loam about 15 inches thick. It is black in the upper part and very dark gray, grayish brown, and black in the lower part. The subsoil is grayish brown, friable loam about 9 inches thick. The underlying material to a depth of about 60 inches is grayish brown and olive brown, mottled loam. The soil generally is calcareous throughout, but in places the surface layer is leached of free lime. In some areas the texture is clay loam. Pockets of gypsum are in the subsoil and the underlying material in many areas.

Included with this soil in mapping are small areas of Canisteo soils, which make up 2 to 5 percent of the unit. These poorly drained, calcareous soils are at slightly lower elevations on the till plain.

Permeability is moderate, and available water capacity is high. Surface runoff is medium to slow. The surface layer is mildly alkaline or moderately alkaline because the content of lime is high. The content of organic matter is high, the content of phosphorus is very low, and the content of potassium is high. The seasonal high water table is at a depth of 3 to 5 feet.

Except for a few islands in undrained areas, most areas are cropped. This soil has good potential for cultivated crops, hay, and pasture. It has fair potential for windbreaks and for most engineering uses.

If adequately fertilized, this soil is suited to all of the crops commonly grown in the county. In places a high content of lime in the surface layer causes a fertility imbalance. The hazard of soil blowing is slight. Drainage of this soil is not needed, but drainage of the adjoining soils makes managing this soil easier. Leaving crop residue on the surface reduces the risk of soil blowing on fall-plowed

fields during winter and spring. The fertility imbalance can be corrected by including a liberal amount of potassium and phosphorus in fertilizers.

The potential of this soil for the trees and shrubs needed in windbreaks is fair. The excessive content of lime adversely affects the uptake of plant nutrients. Chlorosis, which results from a lack of iron, occurs in plants. This condition is best controlled by planting trees and shrubs that can tolerate the high content of lime. Soil blowing can be controlled on bare knobs by maintaining a cover of crop residue. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides.

The seasonal high water table adversely affects many engineering uses. On sites for dwellings with basements, it generally can be controlled by installing drainage tile on the outer side of the footings. A cover of more suitable material is often used under foundations, footings, and floors to prevent the structural damage caused by settlement of the soil. Septic tank absorption fields work poorly during wet periods when the water table is high. The high susceptibility to frost action on local roads and streets can be overcome by removing surface water and by adding a cover of more suitable base material. Special design or precautions are needed if the small areas of included Canisteo soils occur on the construction site. These soils have a shallower seasonal high water table than the Seaforth soil. Capability subclass IIs; not assigned to a range site.

437E—Buse loam, 18 to 25 percent slopes. This steep, well drained soil is on ridges and side slopes along streams and drainageways and around the edges of ponds and lakes. A few stones and boulders are on the surface. Spots of sand and gravel are on some ridgetops. Slopes are convex and simple. Individual areas generally are long and narrow and are 3 to 25 acres in size.

Typically, the surface layer is very dark gray loam about 7 inches thick (fig. 10). The next 8 inches is very dark gray and brown loam that has many worm casts and root channels. The underlying material to a depth of about 60 inches is dark yellowish brown, dark grayish brown, and light olive brown loam. The soil generally is calcareous throughout, but in places part or all of the surface layer lacks free lime.

Included with this soil in mapping are small areas of Lamoure, La Prairie, and Rauville soils in the drainageways that dissect this unit. Also included are the moderately well drained Darnen soils on the concave parts of foot slopes. Included soils make up 5 to 20 percent of the unit.

Permeability is moderate to moderately slow, and available water capacity is high. Surface runoff is very rapid. The surface layer is mildly alkaline. The content of organic matter is moderate, the content of phosphorus is very low, and the content of potassium is medium. The seasonal high water table is at a depth of more than 6 feet.

Most areas are used for grazing. This soil has poor potential for cultivated crops. It has fair potential for range and pasture and poor potential for windbreaks and for most engineering uses.

Most areas are used for range. They generally have been overgrazed. As a result, the native grass species have declined in vigor and decreased in abundance. They have been replaced by less productive grasses, mainly Kentucky bluegrass and weeds, such as gumweed, buckbrush, and goldenrod. Proper stocking rates, timely deferment of grazing, uniform distribution of grazing, and a planned grazing system improve the range and keep the range and the soil in good condition. Potential pond reservoir sites are common.

A few small areas in fields of less sloping soils are used for cultivated crops. Hay and pasture are the main crops. Oats are grown only to reestablish permanent hay or pasture. The hazard of erosion is very severe in cropped areas. Because of the very rapid runoff, this soil is droughty. Gullies should be shaped and seeded to form grassed waterways. Diversion terraces can be built on some of the slopes above these soils to prevent or retard the formation of gullies.

This soil is too steep for windbreaks but is suitable for other plantings. The hazard of erosion is severe if the surface is disturbed. Planting sites can be prepared by furrowing on the contour or by scalping away the sod for individual trees and shrubs. Mortality of trees and shrubs during the first year is slight to severe, depending on the aspect and the slope position. Conditions are less favorable on hot, dry, south-facing and west-facing slopes. More species of trees and shrubs can be grown on the cooler, more moist north-facing and east-facing slopes. Weeds and grasses can be controlled by approved herbicides or by hand methods, such as hoeing.

This soil is poorly suited to most engineering uses because slopes are steep. Septic tank absorption fields are very difficult to construct on this soil. In addition, special design is needed to overcome the problems of lateral seepage and downslope flow. If roads are built, special design and seeding, mulching, and sodding are needed. The soil material is suitable for the subgrade in roads, but stronger material that is less susceptible to frost action is more suitable in the base. Good sites for dwellings generally are above the areas of this soil on side slopes. Capability subclass VIe; Thin Upland range site.

437F—Buse loam, 25 to 40 percent slopes. This very steep, well drained soil is on side slopes and ridges along rivers, creeks, and deep drainageways. A few stones and boulders are on the surface and in the soil in most places. Shallow, narrow drainageways dissect this soil at irregular intervals. Small sandy and gravelly spots are on some of the crests of slopes. Slopes are convex, simple, and about 150 feet long. Individual areas are long and narrow and are 3 to 50 acres in size.

Typically, the surface layer is very dark gray loam about 7 inches thick. The next 7 inches is very dark gray and brown loam that has many worm casts and root chan-

nels. The underlying material to a depth of about 60 inches is dark yellowish brown, dark grayish brown, and light olive brown loam glacial till. The soil generally is calcareous throughout, but in places part or all of the surface layer lacks free lime.

Included with this soil in mapping are narrow areas of Lamoure, La Prairie, and Rauville soils in the drainageways that dissect this unit and moderately well drained Darnen soils on the concave parts of foot slopes. These soils make up 10 to 20 percent of the unit.

Permeability is moderate to moderately slow, and available water capacity is high. Surface runoff is very rapid. The surface layer is mildly alkaline. The content of organic matter is moderate, the content of phosphorus is very low, and the content of potassium is medium. The seasonal high water table is at a depth of more than 6 feet.

Most areas are used for grazing. This soil has poor potential for cultivated crops, fair to poor potential for range and pasture, and poor potential for windbreaks and most engineering uses.

This soil is too steep for crops. It is best suited to range. Most areas have been overgrazed. As a result, native grass species have declined in vigor and decreased in abundance and have been replaced by less productive grasses, mainly Kentucky bluegrass and weeds, such as buckbrush, gumweed, and goldenrod. Proper stocking rates, uniform distribution of grazing, timely deferment of grazing, and a planned grazing system improve the range and keep the range and the soil in good condition. Potential pond reservoir sites are common.

This soil is too steep for windbreaks but is suitable for other plantings. The hazard of erosion is severe if the surface is disturbed. Planting sites can be prepared by scalping away the sod for individual trees and shrubs. Mortality of trees and shrubs during the first year is slight to severe, depending on the aspect and slope position. Conditions are less favorable on hot, dry south-facing and west-facing slopes. More species of trees and shrubs can be grown on the cooler north-facing and east-facing slopes. Weeds and grasses can be controlled by approved herbicides or by hand methods, such as hoeing.

This soil is very poorly suited to most engineering uses because slopes are very steep. If roads are built on this soil, special care and design and seeding, mulching, and sodding are needed to control erosion and prevent the formation of gullies. Good sites for dwellings generally are above the areas of this soil on side slopes. Capability subclass VIIe; Thin Upland range site.

446—Normania loam, 1 to 3 percent slopes. This nearly level, moderately well drained soil is on the lower, slightly concave parts of side slopes and on the upper parts of drainageways on the lowland plain. Individual areas are irregular in shape and range from 4 to 40 acres in size. Slopes are mostly slightly concave, but in large open areas they are plane.

Typically, the surface layer is about 17 inches thick. The upper part is black loam, and the lower part is very dark gray loam that has many dark grayish brown worm casts. The subsoil is about 19 inches thick. It is dark grayish brown, friable loam in the upper part and olive brown, mottled, calcareous, friable loam in the lower part. The underlying material to a depth of about 60 inches is grayish brown and gray, mottled, calcareous loam glacial till.

Included with this soil in mapping are small areas of Ves, Seaforth, Darnen, Canisteo, and Glencoe soils. These soils make up 5 to 15 percent of the unit. The well drained Ves soils and moderately well drained, calcareous Seaforth soils are in slightly convex areas; the moderately well drained Darnen soils are on foot slopes and in other areas where the surface layer is more than 24 inches thick; the poorly drained Canisteo soils are in the nearly level, lower lying areas; and the very poorly drained Glencoe soils are in slight depressions.

Permeability is moderate, and available water capacity is high. Surface runoff is medium to slow. The surface layer is neutral or slightly acid. The content of organic matter and potassium is naturally high, and the content of phosphorus is very low. The seasonal high water table is at a depth of 3 to 6 feet.

Most areas are cropped. This soil has good potential for cultivated crops, range, and windbreaks. It has good or fair potential for most engineering uses.

This soil is well suited to all of the crops commonly grown in the county. It has few limitations, and it can be cropped intensively. Because it is moderately well drained, it does not dry out so quickly in spring as the nearby well drained Ves soils and cannot be worked so early. Leaving crop residue on the surface of fall-plowed fields helps to maintain good structure and tilth.

This soil is well suited to the trees and shrubs needed in windbreaks. Texture and drainage characteristics allow deep penetration of moisture and roots and uniform distribution of roots. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides. If the site for a windbreak is in sod, plowing and disking during the summer or fall before planting increase the moisture supply and kill unwanted vegetation.

The seasonal high water table adversely affects most engineering uses. It can be controlled on sites for dwellings with basements by installing tile around the footings. Septic tank absorption fields work poorly in the spring. Local roads and streets on this soil are more stable if a cover of stronger material that is less susceptible to frost action is added. The underlying material is suitable in the subgrade. This soil is a good source of topsoil. The small areas of included better drained soils provide possible sites for dwellings and absorption fields. Special design or precautions are needed if the small areas of included Canisteo or Glencoe soils occur on the construction site. These soils have a shallower seasonal high water table than the Normania soil. Capability class I; not assigned to a range site.

450—Rauville silty clay loam. This nearly level, very poorly drained, calcareous soil is in old stream channels

and other low, wet areas along rivers and creeks and in some of the wet, marshy drainageways that dissect the Coteau slope. It is subject to flooding. If it has been pastured, it has a hummocky surface. Individual areas range from 15 to 150 acres in size.

Typically, the surface layer is calcareous silty clay loam about 38 inches thick. The upper part is black; the next part is very dark gray, black, and dark gray; and the lower part is black. The underlying material to a depth of about 60 inches is very dark gray, calcareous silty clay loam. In a few spots sandy, gravelly, and stony material has been deposited along the streams. In a few places lime has been leached out of the upper part of the surface layer.

Included with this soil in mapping are a small acreage of marshes and springs on bottom land, a few areas where the soil formed in loamy alluvial sediments, some areas where sand and gravel are at a depth of more than 40 inches, and some small areas of Lamoure and La Prairie soils. These included areas make up 5 to 25 percent of the unit.

Permeability is moderate or moderately slow, and available water capacity is high. Surface runoff is very slow or ponded. The surface layer is mildly alkaline or moderately alkaline. The content of organic matter is high, the content of phosphorus is very low, and the content of potassium is medium. Except for long dry periods, the seasonal high water table is at or near the surface most of the time.

Most areas are used as wildlife habitat. This soil has poor potential for range, cropland, windbreaks, and engineering uses. It has good potential for wetland wildlife habitat.

This soil is too low and too wet to be drained and used as cropland. The wetness is a severe limitation, and flooding is a severe hazard. In most areas the grass species are undesirable for range. If drainage and flood control can be provided, the improved areas have good to fair potential for cropland.

This soil is not suited to trees because most areas are wet and frequently flooded. If areas are improved, however, the species of trees that can tolerate the high content of lime and the wetness can be grown.

This soil has poor potential for most engineering uses because of the frequent flooding and the seasonal high water table. If local roads are to cross areas of this soil, onsite investigation is needed to determine the extent of flooding and the kind of alluvial sediments. Capability subclass VIw; Wetland range site.

494B—Darnen loam, 2 to 6 percent slopes. This gently sloping, moderately well drained soil occurs as narrow, concave strips along the foot of the steeper slopes and at the upper end of drainageways. Most areas are 3 to 10 acres in size.

Typically, the surface layer is black loam about 27 inches thick. The subsoil is friable loam about 20 inches thick. The upper part is very dark grayish brown and dark brown, and the lower part is very dark grayish brown and olive brown and is slightly calcareous. The underlying material to a depth of about 60 inches is olive brown, mottled, calcarous loam. Thin gravelly, sandy, or cobbly layers are common in the underlying material. In some areas the surface layer is less than 24 inches thick.

Included with this soil in mapping are a small acreage of the nearly level Darnen soils, a small acreage of the more sloping Darnen soils, and small areas of La Prairie soils. These soils make up 2 to 7 percent of the unit. The moderately well drained La Prairie soils are on the bottom land next to the Darnen soils on foot slopes. They are subject to flooding.

Permeability is moderate, and available water capacity is high. Surface runoff is medium to slow. Reaction in the surface layer is neutral. The content of organic matter is high, the content of phosphorus is low, and the content of potassium is medium. In most areas the seasonal high water table is at a depth of more than 6 feet, but in some it is between 3 and 6 feet.

Most areas are cropped. Because this soil commonly is adjacent to steeper soils, many areas are used for grazing. The soil has good potential for cultivated crops, hay crops, range, and windbreaks. It has fair potential for most engineering uses.

This soil is well suited to corn, small grain, soybeans, and alfalfa. The hazard of erosion is slight. If erosion occurs on the adjacent higher lying soils, the eroded soil material is likely to injure or smother the plants growing on this soil. Terraces and contour rows should be on a slight grade so that water does not collect between the rows. Grassed waterways are needed in areas where water collects on and crosses this soil.

This soil is well suited to the trees and shrubs needed in windbreaks. Texture and drainage characteristics allow deep penetration of moisture and roots and uniform distribution of roots. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides. If the site for a windbreak is in sod, plowing and disking during the summer or fall before planting increase the moisture supply and kill unwanted vegetation.

This soil has fair potential for septic tank absorption fields, sites for dwellings, and local roads and streets. The moderate permeability, a limitation in septic tank absorption fields, can be overcome by increasing the size of the field. If buildings are constructed on this soil, artificial drainage and more suitable base material help to overcome the moderate shrink-swell potential. If roads are built on this soil, good drainage along the roadway is needed and the thick surface layer should be replaced with more suitable base material. This soil is a very good source of topsoil. Capability subclass IIe; Overflow range site.

894D2—Storden-Everly complex, 12 to 18 percent slopes, eroded. This map unit consists of well drained, moderately steep soils along the sides and at the head of drainageways. A few stones and boulders are on the surface and in the soil. Slopes are convex, simple, and 150 to

200 feet long. Individual areas are long and narrow and are mostly 3 to 15 acres in size.

Storden loam, which makes up 50 to 75 percent of the mapped areas, is on the steepest, most convex middle part of side slopes. Everly clay loam, which makes up 30 to 45 percent of the mapped areas, is on the more gentle, less convex upper and lower parts of side slopes. In large areas on eroded hillsides, the yellowish underlying material of the Storden soil is exposed. On the fringes of these areas, the brownish subsoil of the Everly soil is exposed. The two soils are so intricately mixed or are in areas so small that it is not practical to separate them in mapping.

Typically, the Storden soil has a grayish brown loam surface layer about 7 inches thick. The underlying material to a depth of about 60 inches is loam glacial till. It is olive brown in the upper part and light olive brown in the lower part. In uneroded areas the surface layer is darker. The soil is calcareous throughout.

Typically, the Everly soil has a clay loam surface layer about 7 inches thick. The subsoil is friable clay loam about 12 inches thick. It is brown in the upper part and dark yellowish brown in the lower part. The underlying material to a depth of about 60 inches is yellowish brown, calcareous loam glacial till mottled with gray. The surface layer is a few inches thicker in pastures and other uneroded areas.

Included with these soils in mapping are small areas of less sloping Everly soils and more sloping Storden soils on side slopes. Also included are small areas of Letri and Darnen soils, which make up 2 to 10 percent of the unit. The poorly drained Letri soils are in narrow drainageways that dissect these soils. The moderately well drained Darnen soils are in narrow areas on the concave part of foot slopes. They have a thick, dark colored surface layer.

Permeability is moderate, and surface runoff is rapid. Available water capacity is high. The surface layer is mildly alkaline or neutral. The content of organic matter is low or moderate, the content of phosphorus is very low, and the content of potassium is medium. The seasonal high water table is at a depth of more than 6 feet.

Most areas are cropped or are used for grazing. These soils have poor potential for cultivated crops, fair potential for hay and pasture, and poor potential for windbreaks and most engineering uses.

Hay and small grain are suitable crops. The hazard of erosion is very severe and the hazard of drought severe because runoff is rapid on these moderately steep soils. Slopes are too steep for terracing. Contour stripcropping and spring plowing help to control erosion. Heavy applications of manure increase productivity in eroded areas. If stripcropping is not practical, erosion can be controlled by growing hay or pasture crops. Waterways should be maintained and in places new ones added.

These soils are too steep for windbreaks but are suitable for other plantings. The hazard of erosion is severe if the surface is disturbed. Planting sites can be prepared by furrowing on the contour or by scalping away the sod for individual trees or shrubs. Mortality of trees and shrubs during the first year is slight to severe, depending on the aspect and slope position. Conditions are less favorable on the hot, dry south-facing and west-facing slopes. More species can be grown on the cooler, more moist north-facing and east-facing slopes. Weeds and grasses can be controlled by approved herbicides or by hand methods, such as hoeing.

The hazard of erosion is severe if these moderately steep soils are used as sites for septic tank absorption fields, roads, or dwellings. Septic tank absorption fields are difficult to construct, and special design is needed to overcome the problems of lateral seepage and downslope flow. Special design is needed if roads are constructed on these soils. Seeding, mulching, and sodding to control erosion also are needed. If used as roadfill, the soils generally are suitable in the subgrade, but stronger soil material that is less susceptible to frost action is needed in the base. Good sites for dwellings generally are above the areas of these soils on side slopes. Capability subclass IVe; not assigned to a range site.

902C2—Barnes-Buse loams, 6 to 12 percent slopes, eroded. This map unit consists of rolling, well drained soils on the sides and at the head of drainageways and around depressions. Slopes are convex and complex and range from 100 to 150 acres in length. Some areas are stony. The yellowish underlying material of the Buse soil is exposed on many eroded hillsides. Individual areas range from 3 to 45 acres. They are 40 to 60 percent Barnes soils and 30 to 50 percent Buse soils. The Buse soils are on the steepest, most convex parts of side slopes, whereas the Barnes soils are on the more gentle, less convex parts. The two soils are so intricately mixed or are in areas so small that it is not practical to separate them in mapping.

Typically, the Barnes soil has a very dark brown loam surface layer about 7 inches thick. The subsoil is friable loam about 12 inches thick. The upper part is yellowish brown, and the lower part is light olive brown and calcareous. The underlying material to a depth of about 60 inches is olive brown, light olive brown, and gray, calcareous loam glacial till. In places the surface layer is black and is a few inches thicker.

Typically, the Buse soil has a very dark gray loam surface layer about 7 inches thick. The underlying material to a depth of about 60 inches is dark yellowish brown, dark grayish brown, and light olive brown loam glacial till. In some areas a 10-inch layer of very dark gray and brown loam that has many worm casts and root channels is below the surface layer. The soil is calcareous throughout.

Included with these soils in mapping are small areas of less sloping Barnes soils and more sloping Buse soils on side slopes. Also included, on knolls and the upper parts of hillsides, are areas where gravelly material is exposed and, on the concave parts of foot slopes, areas of the moderately well drained Darnen soils. Included areas make up 5 to 15 percent of the unit.

Permeability is moderate, surface runoff is medium, and available water capacity is high. Reaction is neutral in the surface layer of the Barnes soil and mildly alkaline in that of the Buse soil. The content of organic matter is moderate in the Barnes soil and low in the Buse soil. In both soils, the content of phosphorus is very low and the content of potassium is medium. The seasonal high water table is at a depth of more than 6 feet.

Most areas are cropped. These soils have fair potential for cultivated crops, hay and pasture, and range. They have good or fair potential for windbreaks and fair potential for most engineering uses.

If erosion is controlled and fertility maintained, these soils are well suited to the crops commonly grown in the county. The hazard of further erosion is moderate to severe. Grassed waterways are needed in areas where water collects. In many areas the slopes are too irregular for terracing and contouring. A meadow crop that helps to control runoff and erosion is needed in the rotation. A high level of management also is needed. Included in a high level of management are spring plowing, heavy applications of manure, return of all crop residue to the soil, and disking instead of plowing for the small grain crop that follows corn in the rotation.

These soils are suited to the trees and shrubs needed in windbreaks. Trees and shrubs planted on the Buse soil have a higher mortality rate and a slower growth rate because of low fertility and excessive lime. Erosion can be controlled by planting on the contour or by maintaining a mulch of crop residue. Weeds and grasses can by controlled in newly established windbreaks by shallow cultivation or approved herbicides. If the site for a windbreak is in sod, plowing and disking during the summer or fall before planting increase the moisture supply and kill unwanted vegetation.

Erosion is a concern if these soils are used for most engineering purposes. It can be controlled on the shoulders and sides of roads by seeding, mulching, and sodding. The hazard of frost heave and shrinking and swelling can be partly overcome on sites for roads by providing good surface drainage and by using material that is less susceptible to frost heave in the base. If dwellings are built on the less sloping foot slopes or ridgetops, the hazard of erosion is easier to control. The moderate permeability, a limitation in septic tank absorption fields, can be overcome by increasing the size of the absorption area. Capability subclass IIIe; Barnes soil in Silty range site, Buse soil in Thin Upland range site.

904B2—Arvilla-Barnes-Buse complex, 2 to 6 percent slopes, eroded. This map unit consists of undulating, somewhat excessively drained and well drained soils on glaciated uplands. The yellowish underlying material of the Buse soil is exposed in spots on eroded hillsides. Individual areas mostly range from 3 to 20 acres in size. They are 30 to 50 percent Arvilla sandy loam, 25 to 40 percent Barnes loam, and 15 to 30 percent Buse loam. Arvilla sandy loam formed in gravelly material on ridges, in pockets, and on knobs. Barnes loam formed in glacial till on the gentler parts of side slopes. Buse loam formed in glacial till on the steeper, more convex parts of side slopes. The three soils are so intricately mixed or are in areas so small that it is not practical to separate them in mapping.

Typically, the Arvilla soil has a very dark gray sandy loam surface layer about 6 inches thick. The subsoil is about 10 inches thick. It is very dark grayish brown, friable sandy loam in the upper part and dark brown, very friable coarse sandy loam in the lower part. The underlying material to a depth of about 60 inches is dark yellowish brown and brown, calcareous gravelly loamy coarse sand. In some areas the gravel deposits are only a few feet thick over glacial till. In places the surface layer is darker colored and a few inches thicker.

Typically, the Barnes soil has a very dark brown loam surface layer about 7 inches thick. The subsoil is about 13 inches thick. It is yellowish brown, friable loam in the upper part and light olive brown, calcareous, friable loam in the lower part. The underlying material to a depth of about 60 inches is olive brown, light olive brown, and gray, calcareous loam glacial till. The original surface layer was several inches thicker. It has lost organic matter as the result of erosion and cropping.

Typically, the Buse soil has a very dark gray loam surface layer about 7 inches thick. The underlying material to a depth of about 60 inches is dark yellowish brown, dark grayish brown, and light olive brown loam glacial till. In places a 10-inch layer of very dark gray and brown loam that has many worm casts and root channels is below the surface layer. The soil is calcareous throughout.

Included with these soils in mapping are small areas of Sioux and Fordville soils, which make up 3 to 10 percent of the unit. The excessively drained Sioux soils are on exposed knobs and escarpments. The well drained Fordville soils are in slightly concave areas.

Permeability is moderately rapid in the surface layer and subsoil of the Arvilla soil and rapid in the underlying gravelly sand. It is moderate in the Barnes and Buse soils. Surface runoff is slow to medium on the Arvilla soil and medium on the Barnes and Buse soils. The surface layer is mildly alkaline, moderately alkaline, or neutral. The content of organic matter is moderate, the content of phosphorus is very low, and the content of potassium is low or medium. The seasonal high water table is at a depth of more than 6 feet.

Most areas are cropped or are used for grazing. These soils have fair to poor potential for cultivated crops, windbreaks, range, and hay crops. The potential for engineering uses varies, depending on the soil and the specific use.

Small grain and hay are suited crops. Except for years when the rainfall is both adequate and timely, the soils are too droughty for corn. The hazard of erosion is moderate. Droughtiness is a moderate limitation on the Arvilla soil because of the low available water capacity. The main management needs are controlling erosion, conserving water, and increasing fertility. In areas where slopes are too irregular for contouring, minimum tillage

and the return of crop residue to the surface help to control erosion and conserve moisture. Spring plowing helps to control soil blowing and erosion, particularly soil blowing. Leaving stubble on the surface during winter helps to trap snow and conserves moisture. A single-row shelterbelt helps to control erosion and conserves moisture.

The Barnes and Buse soils are better suited than the Arvilla soil to trees and shrubs. In windbreaks on the Arvilla soil, mortality is likely to be severe if drought occurs while the trees and shrubs are becoming established. This can be partly overcome by providing special care in site preparation and in planting and by weed control. Water erosion and soil blowing can be controlled by maintaining a mulch of crop residue. In places windbreaks can be planted on the contour. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides. If the site for a windbreak is in sod, plowing and disking during the summer or fall before planting increase the moisture supply and kill unwanted vegetation.

These soils are suited to septic tank absorption fields. These absorption fields function well on the Arvilla soil, but contamination of underground water is a hazard because of rapid permeability through the gravelly material. The Arvilla soil is a good source of roadfill. All three soils are suited as sites for local roads and streets and dwellings. The underlying material of the Barnes and Buse soils is suitable in the subgrade, but stronger material that is less susceptible to frost action is needed in the base. Because the soil material varies, onsite inspection and soil borings are needed to determine the suitability of a site for a specific use. Capability subclass IIIe; Arvilla soil in Shallow to Gravel range site, Barnes soil in Silty range site, Buse soil in Thin Upland range site.

904C2—Arvilla-Buse-Barnes complex, 6 to 12 percent slopes, eroded. This map unit consists of rolling, somewhat excessively drained and well drained soils on glaciated uplands. The yellowish underlying material of the Buse soil is exposed on eroded hillsides. Individual areas range from 3 to 25 acres in size. They are 35 to 50 percent Arvilla sandy loam, 25 to 40 percent Buse loam, and 15 to 25 percent Barnes loam. The Arvilla soil is on gravelly knobs or ridges or in pockets of glacial till; the Buse soil is on the steeper, more convex parts of side slopes; and the Barnes soil formed in glacial till on the more gentle parts of side slopes. The three soils are so intermingled or are in areas so small it is not practical to separate them in mapping.

Typically, the Arvilla soil has a very dark gray sandy loam surface layer about 6 inches thick. The subsoil is about 8 inches thick. It is very dark grayish brown, friable sandy loam in the upper part and dark brown, very friable coarse sandy loam in the lower part. The underlying material to a depth of about 60 inches is dark yellowish brown and brown, calcareous gravelly loamy coarse sand. The surface layer is darker and a few inches thicker in uncultivated areas. In some areas the gravel deposits are only a few feet thick over glacial till.

Typically, the Buse soil has a very dark gray loam surface layer about 7 inches. The underlying material to a depth of about 60 inches is dark yellowish brown, dark grayish brown, and light olive brown loam glacial till. In some areas a 10-inch layer of very dark gray and brown loam that has many worm casts and root channels is below the surface layer. The soil is calcareous throughout.

Typically, the Barnes soil has a very dark brown surface layer about 7 inches thick. The subsoil is friable loam about 12 inches thick. It is yellowish brown in the upper part and light olive brown and calcareous in the lower part. The underlying material to a depth of about 60 inches is olive brown, light olive brown, and gray, calcareous loam glacial till. The surface layer is black and is a few inches thicker in places. In a few areas it is clay loam or sandy clay loam.

Included with these soils in mapping are small areas of Sioux and Darnen soils, which make up 5 to 10 percent of the unit. The excessively drained Sioux soils are on knobs and the crests of hills where gravelly material is exposed. The moderately well drained Darnen soils are on foot slopes and in drainageways. They have a thick, dark colored surface layer.

Permeability is moderately rapid in the surface layer and subsoil of the Arvilla soil and rapid in the underlying sand and gravel. It is moderate in the Buse and Barnes soils. Available water capacity is low in the Arvilla soil and high in the Buse and Barnes soils. The surface layer is neutral, mildly alkaline, or moderately alkaline. The content of organic matter is moderate, the content of phosphorus is very low, and the content of potassium is low or medium. In the Arvilla soil roots are restricted by the underlying sand and gravel at a depth of 12 to 18 inches. The seasonal high water table is at a depth of more than 6 feet.

Most areas are cropped. These soils have poor potential for cultivated crops and fair potential for range and windbreaks. The potential for engineering uses varies, depending on the soil and the specific use.

Small grain and hay are the best suited crops. The hazard of erosion is severe. The hazard of drought is severe on the Arvilla soil. The main management needs are controlling erosion, conserving water, and improving fertility. Spring plowing, heavy applications of manure, and return of all crop residue to the soil are needed. Terraces generally are not built on these soils because the Arvilla soil is shallow over gravelly sand. Some waterways should be maintained and some reestablished. If gravelly sand has been exposed by erosion in waterways, the addition of a layer of soil promotes the growth of grasses.

The Buse and Barnes soils are better suited than the Arvilla soil to trees. Mortality is likely to be severe on the Arvilla soil if drought occurs while the trees and shrubs are becoming established. This can be partly overcome by providing special care in site preparation and in planting and by weed control. Water erosion and soil blowing can be controlled by maintaining a cover of crop

residue. In places windbreaks can be planted on the contour. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides. If the site for a windbreak is in sod, plowing and disking during the summer or fall before planting increase the moisture supply and kill unwanted vegetation.

Because these soils vary, onsite inspection and soil borings are needed to determine the suitability of a site for a specific engineering use. The Arvilla soil is a good source of roadfill. Small gravel pits are in some areas. Roadfill from areas of Buse and Barnes soils is suitable in the subgrade, but stronger material that is less susceptible to frost action is needed in the base. Except for construction problems caused by slope, septic tank absorption fields are suitable in these soils. In some areas of the Arvilla soil, contamination of underground water is a hazard because of rapid permeability through the gravelly material. The Arvilla soil is well suited as a site for dwellings and local roads and streets. The Buse and Barnes soils are also suitable if the hazards of frost action and erosion and the shrinking and swelling are overcome. Capability subclass IVe; Arvilla soil in Shallow to Gravel range site, Buse soil in Thin Upland range site, Barnes soil in Silty range site.

913D2—Buse-Barnes loams, 12 to 18 percent slopes, eroded. This map unit consists of moderately steep, well drained soils on the sides and at the head of drainageways. Slopes are convex, simple, and about 150 feet long. In places the surface is stony. Individual areas range from 3 to 15 acres in size. They are 55 to 75 percent Buse soil and 25 to 40 percent Barnes soil. The Buse soil is on the steepest, most convex hillsides, whereas the Barnes soil is on the upper and lower parts of more gentle hillsides. Some sandy and gravelly spots are on the crests of slopes. In large areas on eroded hillsides, the yellowish underlying material of the Buse soil is exposed. The brownish subsoil of the Barnes soil has been exposed on the fringes. The two soils are so intermingled or are in areas so small that it is not practical to separate them in mapping.

Typically, the Buse soil has a very dark gray loam surface layer about 7 inches thick. The underlying material to a depth of about 60 inches is dark yellowish brown, dark grayish brown, and light olive brown loam. In some areas an 8-inch layer of very dark gray and brown loam that has many worm casts and root channels is below the surface layer. The soil is calcareous throughout.

Typically, the Barnes soil has a very dark brown loam surface layer about 7 inches thick. The subsoil is friable loam about 10 inches thick. It is yellowish brown in the upper part and light olive brown and calcareous in the lower part. The underlying material to a depth of about 60 inches is olive brown, light olive brown, and gray, calcareous loam glacial till. The original surface layer has lost organic matter as a result of erosion and cropping. In places the surface layer is black and is a few inches thicker. In a few areas it is clay loam or sandy clay loam.

Included with these soils in mapping are small areas of less sloping Barnes soils and more sloping Buse soils on side slopes. Also included are small, narrow areas of the moderately well drained Darnen soils on the concave parts of foot slopes and drainageways. The Darnen soils make up 2 to 10 percent of the unit.

Permeability is moderate, and available water capacity is high. Surface runoff is rapid to very rapid. The surface layer of the Buse soil is mildly alkaline, and that of the Barnes soil is neutral. The content of organic matter is moderate or low, the content of phosphorus is very low, and the content of potassium is medium. The seasonal high water table is at a depth of more than 6 feet.

Most areas are cropped or are used for grazing. These soils have poor potential for cultivated crops; fair potential for range, hay, and pasture; and poor potential for windbreaks and most engineering uses.

Hay and small grain are suitable crops. The hazard of erosion is very severe and the hazard of drought severe because runoff is rapid on these moderately steep soils. Slopes are too steep for terracing. Contour stripcropping, spring plowing, and minimum tillage help to control erosion. Heavy applications of manure increase productivity in eroded areas. If stripcropping is not practical, erosion can be controlled by growing hay or pasture crops. Waterways should be maintained and in places new ones added.

Many areas are used for range. Most of the areas in range have been overgrazed. As a result, the native grass species have declined in vigor and decreased in abundance and have been replaced by less productive grasses, mainly Kentucky bluegrass and such weeds as goldenrod, gumweed, and buckbrush. Proper stocking rates, timely deferment of grazing, uniform distribution of grazing, and a planned grazing system improve the range and keep the range and the soil in good condition. Potential pond reservoir sites are common.

These soils are too steep for windbreaks but are suitable for other plantings. The hazard of erosion is severe if the surface is disturbed. Planting sites can be prepared by furrowing on the contour or by scalping away the sod for individual trees or shrubs. Mortality of trees and shrubs during the first year is slight to severe, depending on the aspect and slope position. Conditions are less favorable on the hot, dry south-facing and west-facing slopes. More species of trees and shrubs can be grown on the cooler, more moist north-facing and east-facing slopes. Weeds and grasses can be controlled by approved herbicides or by hand methods, such as hoeing.

The hazard of erosion is severe if these moderately steep soils are used as sites for septic tank absorption fields, roads, or dwellings. Septic tank absorption fields are difficult to construct, and special design is needed to overcome lateral seepage and downslope flow. Special design is needed if roads are constructed on these soils. Seeding, mulching, and sodding also are needed to control erosion. If used as roadfill, the soils contain material that generally is suitable in the subgrade, but stronger soil

material that is less susceptible to frost action is needed in the base. Good sites for dwellings generally are above the areas of these soils on side slopes. Capability subclass IVe; Buse soil in Thin Upland range site, Barnes soil in Silty range site.

915C2—Forman-Buse complex, 6 to 12 percent slopes, eroded. This map unit consists of sloping, well drained soils along drainageways on the Coteau slope. A few stones and boulders are on the surface and in the soil. Shallow drainageways dissect the slopes at irregular intervals. Slopes are simple, convex, and 150 to 200 feet long. Individual areas range from 3 to 40 acres. Forman clay loam, which makes up 40 to 60 percent of the mapped areas, has the more gentle, less convex slopes. Buse loam, which makes up 35 to 50 percent of the areas, has steeper, more convex slopes. In large areas on many eroded hillsides, the yellowish underlying material of the Buse soil is exposed. The two soils are so intricately mixed or are in areas so small that it is not practical to separate them in mapping.

Typically, the Forman soil has a very dark gray clay loam surface layer about 7 inches thick. The subsoil is about 12 inches thick. It is dark brown, firm clay loam in the upper part and light olive brown, calcareous, friable clay loam in the lower part. The underlying material to a depth of about 60 inches is grayish brown, calcareous clay loam glacial till. The till is loam in places.

Typically, the Buse soil has a very dark gray loam surface layer about 7 inches thick. The underlying material to a depth of about 60 inches is dark yellowish brown, dark grayish brown, and light olive brown clay loam or loam. In places an 8-inch layer of very dark gray and brown loam that has many worm casts and root channels is between the surface layer and the underlying material. The soil is calcareous throughout.

Included with these soils in mapping are small areas of less sloping Forman soils and more sloping Buse soils on side slopes. Also included are small areas of Darnen and Flom soils, which make up 3 to 8 percent of the unit. The moderately well drained Darnen soils are in concave areas at the foot of side slopes. The poorly drained Flom soils are in the narrow drainageways that dissect this unit.

Permeability is moderate or moderately slow. Available water capacity is high, and surface runoff is rapid. The surface layer of the Forman soil is neutral in most places, whereas that of the Buse soil is mildly alkaline. The content of organic matter is moderate in the Forman soil and low in the Buse soil. In both soils, the content of phosphorus is low and the content of potassium is medium. The seasonal high water table is at a depth of 6 feet or more.

Most areas are cropped. These soils have fair potential for cultivated crops, good or fair potential for windbreaks, and good potential for hay crops and range. They have fair potential for most engineering uses.

If erosion is controlled and fertility maintained, these soils are well suited to the crops commonly grown in the county. The hazard of further erosion is moderate to severe. Grassed waterways are needed in areas where water collects. If slopes are too irregular for terracing and contouring, a rotation that includes a meadow crop is needed to control runoff and erosion. A high level of management also is needed. Included in a high level of management are spring plowing, heavy applications of manure, return of all crop residue to the soil, and disking instead of plowing for the small grain crop that follows corn in the rotation.

These soils are suited to the trees and shrubs needed in windbreaks. Trees and shrubs planted on the Buse soil have a higher mortality rate because of low fertility and excessive lime. Erosion can be controlled by planting on the contour or by maintaining a mulch of crop residue. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation, approved herbicides, and hand methods, such as hoeing. If the site for a windbreak is in sod, plowing and disking during the summer or fall before planting increase the moisture supply and kill unwanted vegetation.

Erosion is a concern if these soils are used for most engineering purposes. It can be controlled on the shoulders and sides of roads by seeding, mulching, and sodding. It is easier to control if dwellings are constructed on the less sloping foot slopes or ridgetops. The hazard of frost heave and the shrinking and swelling can be overcome on sites for local roads and streets by providing good drainage and by using a blanket of more suitable base material. A cover of more suitable material is often used under the foundations, footings, and floors of dwellings to prevent the structural damage caused by shrinking and swelling. The moderate or moderately slow permeability, a limitation in septic tank absorption fields, can be overcome by increasing the size of the absorption area. Capability subclass IIIe; Buse soil in Thin upland range site, Forman soil in Silty range site.

915D2—Buse-Forman complex, 12 to 18 percent slopes, eroded. This map unit consists of moderately steep, well drained soils along drainageways on the Coteau slope. In places the surface is stony. Slopes are convex, simple, and 150 to 200 feet long. Individual areas range from 3 to 20 acres in size. They are 50 to 75 percent Buse loam and 25 to 45 percent Forman clay loam. The Forman soil is on the upper and lower parts of slopes. The Buse soil is on the steepest, most convex parts of slopes. In large areas on many eroded side slopes, the yellowish underlying material of the Buse soil is exposed. The two soils are so intermingled or are in areas so small that it is not practical to separate them in mapping.

Typically, the Buse soil has a very dark gray loam surface layer about 7 inches thick. The underlying material to a depth of about 60 inches is dark yellowish brown, dark grayish brown, and light olive brown loam. In places an 8-inch layer of very dark gray and brown loam that has many worm casts and root channels is between the surface layer and the underlying material.

Typically, the Forman soil has a very dark gray clay loam surface layer about 7 inches thick. The subsoil is about 10 inches thick. It is dark brown, firm clay loam in the upper part and light olive brown, calcareous, friable clay loam in the lower part. The underlying material to a depth of about 60 inches is grayish brown, calcareous clay loam glacial till. The till is loam in places.

Included with these soils in mapping are small areas of less sloping Forman soils and more sloping Buse soils on side slopes. Also included are narrow areas of Lamoure, La Prairie, and Rauville soils in the drainageways that dissect this unit and the moderately well drained Darnen soils that occupy the concave parts of foot slopes.

Permeability is moderate to moderately slow. Available water capacity is high, and surface runoff is rapid. The surface layer of the Buse soil is mildly alkaline. That of the Forman soil typically is neutral, but it is mildly alkaline in areas where the Forman and Buse soils are closely associated. The content of organic matter is low in the Buse soil and moderate in the Forman soil. In both soils, the content of phosphorus is low and the content of potassium is medium. The seasonal high water table is at a depth of more than 6 feet.

Most areas are cropped or are used for grazing. These soils have poor potential for cultivated crops; fair potential for range, hay, and pasture; and poor potential for windbreaks and most engineering uses.

Hay and small grain are suitable crops. The hazard of erosion is very severe and the hazard of drought severe because runoff is rapid on these moderately steep soils. Slopes are too steep for terracing. Contour stripcropping, spring plowing, and minimum tillage help to control erosion. Heavy applications of manure increase productivity. If stripcropping is not practical, erosion can be controlled by growing hay or pasture crops. Waterways should be maintained and in places new ones added.

Many areas are used for range. Most of the areas in range have been overgrazed. As a result, the native grass has declined in vigor and decreased in abundance and has been replaced by less productive grasses, mainly Kentucky bluegrass and such weeds as goldenrod and buckbrush. Proper stocking rates, timely deferment of grazing, uniform distribution of grazing, and a planned grazing system improve the range and keep the range and the soil in good condition. Potential pond reservoir sites are common.

These soils are too steep for windbreaks but are suitable for other plantings. The hazard of erosion is severe if the surface is disturbed. Planting sites can be prepared by furrowing on the contour or by scalping away the sod for individual trees and shrubs. Mortality of trees and shrubs during the first year is slight to severe, depending on the aspect and slope position. Conditions are less favorable on the hot, dry south-facing and west-facing slopes. More species of trees and shrubs can be grown on the cooler, more moist north-facing and east-facing slopes. Weeds and grasses can be controlled by approved herbicides or by hand methods, such as hoeing.

The hazard of erosion is severe if these moderately steep soils are used as sites for septic tank absorption fields, roads, and dwellings. Septic tank absorption fields are difficult to construct, and special design is needed to overcome lateral seepage and downslope flow. Special design is needed if roads are constructed on these soils. Also, seeding, mulching, and sodding are needed to control erosion. If used as roadfill, the soils contain material that generally is suitable in the subgrade, but stronger soil material that is less susceptible to frost action is more suitable in the base. Good sites for dwellings generally are above the areas of these soils on side slopes. Capability subclass IVe; Buse soil in Thin Upland range site, Forman soil in Silty range site.

917D2—Buse-Sioux complex, 12 to 18 percent slopes, eroded. This map unit consists of moderately steep, well drained and excessively drained soils on glaciated uplands. Numerous small stones and pebbles are on the surface of the Sioux soil. In large areas on eroded hillsides, the yellowish underlying material of the Buse soil is exposed. Slopes are convex, complex, and about 150 feet long. Individual areas range from 3 to 20 acres in size. They are 40 to 60 percent Buse loam and 35 to 50 percent Sioux gravelly sandy loam. The Buse soil formed in glacial till on the steeper, more convex side slopes. The Sioux soil formed in gravelly outwash on ridges or glacial outwash in pockets or on knobs. The two soils are so intricately mixed or are in areas so small that it is not practical to separate them in mapping.

Typically, the Buse soil has a very dark gray loam surface layer about 7 inches thick. The underlying material to a depth of about 60 inches is dark yellowish brown, dark grayish brown, and light olive brown loam glacial till. In places an 8-inch layer of very dark gray and brown loam that has many worm casts and root channels is below the surface layer. The soil is calcareous throughout.

Typically, the Sioux soil has a very dark gray gravelly sandy loam surface layer about 7 inches thick. The underlying material to a depth of about 16 inches is dark grayish brown and dark yellowish brown gravelly coarse sand. Below this to a depth of about 60 inches is dark yellowish brown and grayish brown very gravelly coarse sand. In places the surface layer is black and is a few inches thicker. The soil is typically calcareous throughout, but in a few places the surface layer is leached of free lime.

Included with these soils in mapping are small areas of Barnes, Sverdrup, and Darnen soils. These included soils make up 10 to 20 percent of the unit. The well drained Barnes soils are on the gentle, convex parts of hillsides; the somewhat excessively drained Sverdrup soils typically are in convex areas near Sioux soils; and the moderately well drained Darnen soils are on the concave part of foot slopes.

Permeability is moderate in the Buse soil and rapid in the Sioux soil. Available water capacity is high in the Buse soil and very low in the Sioux soil. Surface runoff is rapid on the Buse soil. The Sioux soil absorbs water readily. In both soils the surface layer is mildly alkaline in

reaction and low or moderate in content of organic matter. The content of phosphorus is very low, and the content of potassium is medium or low. The root zone is severely restricted in the Sioux soil by the underlying sand and gravel at a depth of 7 to 12 inches. The seasonal high water table is at a depth of more than 6 feet.

Most areas are cropped or are used for grazing. These soils have poor potential for cultivated crops and fair to poor potential for range, hay, and pasture. They have poor potential for windbreaks and for most engineering uses.

These soils are best suited to hay and pasture. They are not suited to corn and other clean-tilled crops. The hazard of erosion is very severe. The hazard of drought is very severe on the Sioux soil because available water capacity is limited. If renewal of the stand of legumes or grasses is needed, small grain, for example, oats or flax, is grown as a nurse crop.

Many areas are used for range. Most of the areas in range have been overgrazed. As a result, the native grass has declined in vigor and decreased in abundance and has been replaced by less productive grasses, mainly Kentucky bluegrass and such weeds as goldenrod, gumweed, and buckbrush. Proper stocking rates, timely deferment of grazing, uniform distribution of grazing, and a planned grazing system improve the range and keep the range and the soil in good condition.

These soils are too steep for windbreaks. The Sioux soil generally is very poorly suited. Onsite inspection is needed to determine the suitability of an area for trees and shrubs. The Buse soil is suitable for other plantings. The hazard of erosion is severe if the surface is disturbed. Planting sites can be prepared by furrowing on the contour or by scalping away the sod for individual trees or shrubs. Mortality of trees and shrubs during the first year is slight to severe, depending on the aspect and slope position. Conditions are less favorable on the hot, dry south-facing and west-facing slopes. More species of trees and shrubs can be grown on the cooler, more moist north-facing and east-facing slopes. Weeds and grasses can be controlled by approved herbicides or by hand methods, such as hoeing.

Onsite inspection and soil borings are needed to determine the suitability of an area for a specific engineering use. The moderately steep slopes restrict use. Septic tank absorption fields are hard to construct, and special design is needed to overcome lateral seepage and downslope flow. If the absorption field is in an area of Sioux soil, contamination of underground water is a hazard because of seepage through the rapidly permeable underlying material. Cutbanks can cave, but this limitation can be overcome by enlarging excavations or by providing retaining walls.

If local roads and streets are constructed on these soils, special design is needed. Also, seeding, mulching, and sodding are needed to control erosion. The Sioux soil is a good source of roadfill. The Buse soil is suitable as material in the subgrade, but it is undesirable as base material because it lacks strength and is susceptible to frost action. Small gravel pits are in some areas of Sioux soil. Capability subclass VIe; Buse soil in Thin Upland range site, Sioux soil in Very Shallow range site.

917E—Buse-Sioux complex, 18 to 40 percent slopes. This map unit consists of well drained and excessively drained, steep and very steep soils along streams and deep drainageways and on gravelly ridges in the glaciated uplands. In the areas of Sioux soil, many small stones and pebbles are on the surface. Individual areas range from 3 to 35 acres in size. They are 40 to 60 percent Buse loam and 40 to 60 percent Sioux gravelly sandy loam. The Buse soil formed in glacial till on the steeper, more convex side slopes. The Sioux soil formed in gravelly glacial outwash on ridges and in glacial outwash in pockets or on knobs.

Typically, the Buse soil has a very dark gray loam surface layer about 6 inches thick. The next 8 inches is very dark gray and brown loam that has many worm casts and root channels. The underlying material to a depth of about 60 inches is dark yellowish brown, dark grayish brown, and light olive brown loam. The soil typically is calcareous throughout, but in places part or all of the surface layer lacks free lime.

Typically, the Sioux soil has a black gravelly sandy loam surface layer about 11 inches thick. The underlying material to a depth of about 16 inches is dark grayish brown and dark yellowish brown gravelly coarse sand. Below this to a depth of about 60 inches is dark yellowish brown and grayish brown very gravelly coarse sand. Typically, the soil is calcareous throughout, but in a few places the surface layer is leached of free lime.

Included with these soils in mapping are small areas of Darnen and Sverdrup soils. These included soils make up 5 to 10 percent of the unit. The moderately well drained Darnen soils are on the concave part of foot slopes, and the somewhat excessively drained Sverdrup soils are above the shoulders of slopes or in slightly concave areas.

Permeability is moderate in the Buse soil and rapid in the Sioux soil. Available water capacity is moderate in the Buse soil and very low in the Sioux soil. Surface runoff is very rapid on the Buse soil and medium to rapid on the Sioux soil. The surface layer in both soils typically is mildly alkaline. The content of organic matter is moderate, the content of phosphorus is very low, and the content of potassium is medium or low. The root zone is restricted in the Sioux soil by the underlying sand and gravel at a depth of 7 to 12 inches. The seasonal high water table is at a depth of more than 6 feet.

Most areas are used for grazing. These soils have poor potential for cultivated crops and hay crops. They have fair potential for range and poor potential for windbreaks and most engineering uses.

These soils are too steep and droughty to be cropped. Some small areas are cropped, if they are within tracts of other soils suitable for crops, but crop growth is poor. The hazards of erosion and drought are very severe.

These soils are best suited to range. Most areas have been overgrazed. As a result, native grass species have

declined in vigor and decreased in abundance and have been replaced by less productive grasses, mainly Kentucky bluegrass and such weeds as buckbrush, gumweed, and goldenrod. Proper stocking rates, uniform distribution of grazing, timely deferment of grazing, and a planned grazing system improve the range and keep the range and the soil in good condition.

Slopes are too steep for windbreaks. The Sioux soil generally is very poorly suited to trees and shrubs. Onsite inspection is needed to determine the suitability of an area. The Buse soil is suitable for other plantings. The hazard of erosion is severe if the surface is disturbed. Planting sites can be prepared by scalping away the sod for individual trees or shrubs. Mortality of trees and shrubs during the first year is slight to severe, depending on the aspect and the slope position. Conditions are less favorable on the hot, dry south-facing and west-facing slopes. More species of trees and shrubs can be grown on the cooler, more moist north-facing and east-facing slopes. Weeds and grasses can be controlled by approved herbicides or by hand methods, such as hoeing.

These soils are poorly suited to most engineering uses because of the steep and very steep slopes. Each area should be carefully inspected to determine the suitability for an intended use because the soils vary. Small gravel pits are in some areas of Sioux soil. They are a good source of roadfill. Capability subclass VIIe; Buse soil in Thin Upland range site, Sioux soil in Very Shallow range site.

953C—Arvilla-Storden-Ves complex, 6 to 15 percent slopes. This map unit consists of rolling and moderately steep, somewhat excessively drained and well drained soils on gravelly ridges on the lowland plain. These ridges are 200 to 300 feet wide and 10 to 25 feet high and generally are oriented north to south. They are dominantly less than a half mile long, but in places they occur intermittently as stretches several miles long. Individual areas range from 5 to 15 acres in size. They are about 45 percent Arvilla sandy loam and other soils that are underlain by sand and gravel and about 40 percent Storden loam and Ves loam. The Arvilla soil is on the ridgetops, the Storden soil is on the steep part of side slopes, and the Ves soil is on the convex, more gentle upper and lower side slopes. The three soils are so intermingled or are in areas so small that it is not practical to map them separately.

Typically, the Arvilla soil has a black sandy loam surface layer about 8 inches thick. The subsoil is about 8 inches thick. It is very dark grayish brown, friable sandy loam in the upper part and dark brown, very friable coarse sandy loam in the lower part. The underlying material to a depth of about 60 inches is dark yellowish brown and brown, calcareous gravelly loamy coarse sand. In cultivated areas the surface layer generally is lighter in color and thinner. In many places the gravel deposits are only a few feet thick over glacial till.

Typically, the Storden soil has a dark grayish brown loam surface layer about 8 inches thick. The underlying material to a depth of about 60 inches is grayish brown, brown, and light olive brown loam glacial till. The soil is calcareous throughout.

Typically, the Ves soil has a black loam surface layer about 8 inches thick. The subsoil is friable loam about 20 inches thick. It is dark yellowish brown and brown in the upper part and light olive brown and calcareous in the lower part. The underlying material to a depth of about 60 inches is olive brown, calcareous loam glacial till. In places the surface layer is a few inches thinner and is lighter colored.

Included with these soils in mapping are small areas of Fordville, Sioux, and Sverdrup soils. These included soils make up 10 to 20 percent of the unit. The Fordville soils have a loam mantle that is more than 20 inches thick over sand and gravel. Gravelly material is exposed on the Sioux soils. Sverdrup soils are sandy.

Permeability is moderately rapid in the surface layer and subsoil of the Arvilla soil and rapid in the underlying sand and gravel. It is moderate in the Storden and Ves soils. Available water capacity is low in the Arvilla soil and high in the Storden and Ves soils. The surface layer in all the soils ranges from neutral to moderately alkaline. The content of organic matter ranges from low to high, the content of phosphorus is very low, and the content of potassium is low or medium. Roots are restricted in Arvilla soil by the underlying sand and gravel at a depth of 12 to 18 inches. The seasonal high water table is at a depth of more than 6 feet.

Most areas are cropped or are used for grazing. These soils have poor potential for cultivated crops and fair potential for pasture. They have fair to poor potential for windbreaks and most engineering uses.

Small grain and hay are the best suited crops. The hazard of erosion is severe. The hazard of drought is severe on the Arvilla soil. The main management needs are controlling erosion, conserving water, and improving fertility. Spring plowing, heavy applications of manure, and return of all crop residue to the soil are needed. Some waterways should be maintained and some reestablished. In areas where gravelly sand has been exposed by erosion in waterways, replacing the top layer promotes the growth of grasses.

Storden and Ves soils are better suited than the Arvilla soil to trees. Mortality of windbreaks planted on the Arvilla soil is likely to be severe if drought occurs while the trees and shrubs are becoming established. This can be partly overcome by providing special care in site preparation and in planting and by weed control. Water erosion and soil blowing can be controlled by maintaining a mulch of crop residue and, in places, by planting windbreaks on the contour. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides. If the site for a windbreak is in sod, plowing and disking during the summer or fall before planting increase the moisture supply and kill unwanted vegetation.

Erosion is a hazard if these soils are used for engineering purposes. It can be controlled along the side of roads by seeding, mulching, and sodding. Septic tank absorption fields work well on these soils. In some areas of the Arvilla soil, pollution of underground water is a hazard because of rapid permeability through the gravelly material. The Arvilla soil is a good source of roadfill. The Storden and Ves soils are suitable as subgrade material, but they are undesirable as base material because they lack strength and are susceptible to frost action. Small gravel pits are in some of the areas of Arvilla soil. Because these soils vary, onsite inspection and soil borings are needed to determine the suitability of an area for a specific engineering use. Capability subclass IVe; not assigned to a range site.

954C2—Storden-Ves loams, 5 to 12 percent slopes, eroded. This map unit consists of sloping and rolling, well drained soils on low hills that rise 10 to 15 feet above the floor of the glaciated lowland plain, on the sides and at head of drainageways, and on hillsides surrounding closed depressions. Spots of sand or gravel are on some ridgetops. Slopes are complex, convex, and 75 to 150 feet long. Individual areas range from 3 to 30 acres in size. They are 35 to 75 percent Storden soils and 25 to 50 percent Ves soils. The Ves soils are on the gentle, less convex parts of hillsides, whereas the Storden soils are on the steepest, most convex parts. The two soils are so intricately mixed or are in areas so small that it is not practical to separate them in mapping.

Typically, the Storden soil has a dark grayish brown loam surface layer about 8 inches thick. The underlying material to a depth of about 23 inches is grayish brown and brown loam. Below this to a depth of about 60 inches is light olive brown loam glacial till. The soil is calcareous throughout.

Typically, the Ves soil has a very dark gray loam surface layer about 8 inches thick. The subsoil is about 20 inches thick. It is dark yellowish brown and brown, friable loam in the upper part and light olive brown, calcareous, friable loam in the lower part. The underlying material to a depth of about 60 inches is olive brown, calcareous loam glacial till. The original surface layer was black and was several inches thicker.

Included with these soils in mapping are small areas of less sloping Ves soils and more sloping Storden soils on side slopes. Also included are small areas of Normania and Canisteo soils, which make up 3 to 10 percent of the unit. The moderately well drained Normania soils are in concave areas that include the upper end of drainageways and some foot slopes. The poorly drained Canisteo soils are in shallow drainageways and other lower lying areas.

Permeability is moderate, and surface runoff is medium to rapid. Available water capacity is high. The surface layer of the Ves soil is neutral in most places, whereas that of the Storden soil is mildly alkaline. The content of organic matter is moderate in the Ves soil and low in the Storden soil. In both soils, the content of phosphorus is low or very low and the content of potassium is medium or high. The seasonal high water table is at a depth of more than 6 feet.

Most areas are cropped. These soils have fair to poor potential for cultivated crops and good potential for hay crops and pasture. They have fair or good potential for windbreaks and fair potential for most engineering uses.

If erosion is controlled and fertility maintained, these soils are well suited to the crops commonly grown in the county. The hazard of further erosion is moderate to severe. Grassed waterways are needed in areas where water collects. In most areas slopes are too irregular for terracing and contouring. In these areas a rotation that includes a meadow crop is needed to control runoff and erosion. Also, a high level of management is needed. This management includes spring plowing, heavy applications of manure, return of all crop residue to the soil, and disking instead of plowing for the small grain crop that follows corn in the rotation.

These soils are suited to the trees and shrubs needed in windbreaks. Trees and shrubs planted on the Storden soil have a higher mortality rate because of low fertility and excessive lime. Erosion can be controlled by planting on the contour or by maintaining a mulch of crop residue. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides. If the site for a windbreak is in sod, plowing and disking during the summer or fall before planting increase the moisture supply and kill unwanted vegetation.

The hazard of erosion is moderate to severe if these soils are used for most engineering purposes. Erosion can be controlled on the shoulders and sides of roads by seeding, mulching, and sodding. If dwellings are built on the less sloping foot slopes or ridgetops, erosion is easier to control. If local roads and streets are to function properly, stronger material that is less susceptible to frost action is needed in the base. In places the moderate permeability is a limitation in septic tank absorption fields, but this limitation can be overcome by increasing the size of the absorption area. Special design or precautions are needed if the small areas of included Canisteo soils occur on the construction site. These soils have a more shallow seasonal high water table than Storden and Ves soils. Capability subclass IIIe; not assigned to a range site.

954D2—Storden-Ves loams, 12 to 18 percent slopes, eroded. This map unit consists of moderately steep, well drained soils along drainageways, around depressions, and along rivers and creeks. A few stones and boulders are on the surface in places. Sandy and gravelly spots are on some ridgetops. Slopes are complex, convex, and 125 to 175 feet long. Individual areas range from 3 to 15 acres in size. They are 40 to 80 percent Storden soils and 20 to 40 percent Ves soils. The Storden soils are in the steepest, most convex areas, and the Ves soils are on the upper and lower parts of slopes. In large areas on eroded hillsides, the yellowish underlying material of the Storden soils is exposed. The two soils are in areas so small or are so intricately mixed that it is not practical to separate them in mapping.

Typically, the Storden soil has a grayish brown surface layer about 7 inches thick. The underlying material to a depth of about 60 inches is grayish brown, brown, and light olive brown loam glacial till. The surface layer is darker in places. The soil is calcareous throughout.

Typically, the Ves soil has a very dark gray surface layer about 8 inches thick. The subsoil is friable loam about 16 inches thick. It is dark yellowish brown and brown in the upper part and light olive brown and calcareous in the lower part. The underlying material to a depth of about 60 inches is olive brown, calcareous loam glacial till. The surface layer is black in places.

Included with these soils in mapping are small areas of less sloping Ves soils and more sloping Storden soils on side slopes. Also included are small areas of Canisteo and Darnen soils, which make up 2 to 10 percent of the unit. The poorly drained Canisteo soils are in the narrow drainageways that dissect some areas of this unit. The moderately well drained Darnen soils occur as narrow strips on the concave part of foot slopes.

Permeability is moderate, available water capacity is high, and surface runoff is rapid. The surface layer of the Storden soil is mildly alkaline, and that of the Ves soil is neutral. The content of organic matter is low in the Storden soil and moderate in the Ves soil. In both soils, the content of phosphorus is very low and the content of potassium is medium. The seasonal high water table is at a depth of more than 6 feet.

Most areas are cropped or are used for grazing. These soils have poor potential for cultivated crops, fair potential for hay and pasture, and poor potential for windbreaks and most engineering uses.

Hay and small grain are suitable crops. The hazard of erosion is very severe and the hazard of drought severe because runoff on these moderately steep soils is rapid. Slopes are too steep for terracing. Contour stripcropping and spring plowing help to control erosion. Heavy applications of manure increase productivity in eroded areas. If stripcropping is not practical, erosion can be controlled by growing hay or pasture crops. Waterways should be maintained and in places new ones added.

These soils are too steep for windbreaks but are suitable for other plantings. The hazard of erosion is severe if the surface is disturbed. Planting sites can be prepared by furrowing on the contour or by scalping away the sod for individual trees or shrubs. Mortality of trees and shrubs during the first year is slight to severe, depending on the aspect and the slope position. Conditions are less favorable on the hot, dry south-facing and west-facing slopes. More species of trees and shrubs can be grown on the cooler, more moist north-facing and east-facing slopes. Weeds and grasses can be controlled by approved herbicides or by hand methods, such as hoeing.

The hazard of erosion is severe if these moderately steep soils are used for most engineering purposes. Septic tank absorption fields are difficult to construct, and special design is needed to overcome lateral seepage and downslope flow. If roads are constructed on these soils, special design is needed. Also, seeding, mulching, and sodding are needed to control erosion. If used as roadfill, the soils generally are suitable as subgrade material, but stronger soil material that is less susceptible to frost action is more suitable in the base. Good sites for dwellings generally are above the areas of these soils on side slopes. Capability subclass IVe; not assigned to a range site.

986—Lamoure and La Prairie soils, frequently flooded. This map unit consists of nearly level, poorly drained and moderately well drained soils along rivers, creeks, and some of the large drainageways. They are on the first bottom and in the main stream channel (fig. 11) and the old stream channels. The Lamoure soils are lower on the bottom land than La Prairie soils, which are generally dissected by stream channels. Individual areas are long and narrow and range from 10 to more than 200 acres in size.

Typically, the Lamoure soil has a silty clay loam surface layer about 25 inches thick. It is black in the upper part and very dark gray in the lower part. The subsoil is very dark gray, mottled, friable silty clay loam about 13 inches thick. The underlying material to a depth of about 60 inches is dark grayish brown, mottled silty clay loam. The soil is calcareous throughout. In small areas along streams, sandy, gravelly, and stony material has been deposited.

Typically, the La Prairie soil has a loam surface layer about 30 inches thick. It is black in the upper part and very dark gray in the lower part. The subsoil is dark grayish brown and very dark gray, friable loam about 10 inches thick. The underlying material to a depth of about 60 inches is very dark grayish brown, mottled, stratified silt loam and fine sand. The soil is calcareous below a depth of about 17 inches. In some areas the surface layer is silt loam or silty clay loam.

Included with these soils in mapping are small areas of the very poorly drained Rauville soils in oxbows and stream channels and narrow areas of the moderately well drained Darnen soils on the foot slopes along the sides of the flood plain. These included soils make up 5 to 15 percent of the unit. Also included are areas, along the Redwood River between Lynd and the lake plain, where the soil is underlain by sand and gravel.

Permeability is moderate, and available water capacity is high. Surface runoff is slow. The surface layer is mildly alkaline. The content of organic matter is high, the content of phosphorus is low, and the content of potassium is medium. The seasonal high water table is at a depth of 1 foot to 3 feet in the Lamoure soil and 3 to 6 feet in the La Prairie soil.

Most areas are used for grazing. These soils have poor potential for cultivated crops and good potential for range. They have poor potential for windbreaks and for most engineering uses.

Most areas are not suitable for crops because they are flooded too often or are too dissected by streams or by old meanders. If the stream channels were improved, many areas could be made suitable for crops.

These soils are well suited to range. Most grazed areas have been overgrazed. As a result, the native grass species have declined in vigor and decreased in abundance and have been replaced by less productive grasses, mainly Kentucky bluegrass and such weeds as gumweed, goldenrod, and buckbrush. Proper stocking rates, uniform distribution of grazing, timely deferment of grazing, and a planned grazing system improve the range and keep the range and the soil in good condition. Potential sites for dugout ponds are plentiful.

Most areas are very poorly suited to trees and shrubs because of frequent overflow. In improved areas, however, many species of trees and shrubs can be grown.

Because the hazard of flooding is severe and wetness is a limitation in places, the potential for dwelling sites, septic tank absorption fields, and most other engineering uses is poor. If local roads are constructed on these soils, onsite investigation is needed to determine the extent of flooding and the proper design. Capability subclass VIw; Lamoure soil in Subirrigated range site, La Prairie soil in Overflow range site.

1016—Udorthents. This map unit consists mainly of nearly level areas where the natural soil has been covered over or cut away or has been removed and covered over. Individual areas range from 3 to 45 acres in size.

The largest areas are in and around Marshall, where much cutting or filling has occurred. The fill material is mostly loam. The underlying material is generally either alluvium or glacial till. These areas have been used for building site development.

These areas dominantly consist of filled and leveled gravel pits, dumps, and landfills. The dumps and landfills and a few of the gravel pits have been filled with trash, rocks, and other debris and then covered with soil material and leveled. Most of the gravel pits have been leveled. These areas are cropped or are used for grazing, wildlife habitat, or recreational development. They have good to poor potential for those uses.

Other areas are scalped areas along roads, highways, and railroads. The upper part of the soil material has been removed and used as roadfill. Some of these areas have steep slopes. Most are farmed with the adjoining land. They are low in fertility, and an increase in organic-matter content is needed. The areas are more suitable cropland if the surface is removed, stockpiled, and replaced after the fill has been obtained. Generally, soil characteristics and qualities vary widely. Onsite investigation and soil borings are needed to determine the suitability of an area for a specific use. Not assigned to a capability subclass or range site.

1029—Pits, gravel. This map unit consists of open excavations from which gravel has been or is being removed. The size, shape, and depth of the pits are influenced by the quality and quantity of gravel. Open water is in some of the deeper pits. Many pits are no longer worked because the supply of quality gravel has been exhausted. Trees, shrubs, and grasses grow in most abandoned pits.

Most of the pits are within areas of Arvilla, Fordville, and Sioux soils. The surface layer has been stripped and deposited around the edges of the gravel pit (fig. 12). It is a fair or good source of topsoil. The coarser gravelly material is then removed, leaving an open pit.

Most abandoned gravel pits are used by wildlife for cover and nesting. Gravel pits that can be leveled have fair to poor potential for crops and pasture. Because soil properties vary widely, onsite investigation is needed to determine the suitability of an area for most uses. Not assigned to a capability subclass or range site.

1032—Aquents and Udorthents. This map unit consists of beaches and sand bars of lakes and ponds. In a few places the surface is stony. Small areas of short, steep escarpments are next to the lakes and ponds.

The soil material is mostly sandy loam but ranges from loamy sand to gravelly loam. Typically, the sandy material is 20 to 40 inches thick over finer textured material. The escarpments generally are loamy till. Natural soil drainage typically is poor but ranges to excessive in places.

Most areas around undrained lakes and ponds are limited by wetness. In some areas drought is a hazard because of low available water capacity.

This map unit is farmed only with adjacent soils because it occurs as bands too narrow to be managed separately. Most areas have poor potential for cultivated crops, fair potential for range and pasture, and good potential for wetland wildlife habitat. Capability subclass IVw.

1053—Aquolls and Aquents, ponded. This map unit consists of undrained, closed depressions and ponds that, except for dry years, are usually covered by 1 foot to 3 feet of water. In scattered areas cattails, reeds, sedges, and other water-tolerant plants grow in the open water. Individual areas are irregularly shaped and range from 3 to several hundred acres in size.

The soil material in most places is somewhat similar to the very poorly drained Glencoe, Quam, Rolfe, and Urness soils. Included in mapping are small areas of poorly drained Vallers, Canisteo, and Colvin soils along the edges of the unit or on islands.

Most areas are used as wildlife habitat. The potential for wetland wildlife habitat is good. The extreme wetness limits other uses. Capability subclass VIIIw; not assigned to a range site.

1809—Bearden complex. This map unit consists mostly of nearly level, somewhat poorly drained, calcareous soils on slight elevations that rise 1 foot to 2 feet above the floor of the lake plain and in the higher areas of overflow channels that lie between some of the streams that dissect the lowland plain. The original surface of the lake plain has been filled in and built up by deposits from overflowing streams. Individual areas are 5 to 100 acres in size.

The Bearden soil makes up about 50 percent of this map unit. Typically, it has a black silty clay loam surface layer about 14 inches thick. The subsoil is about 23 inches

thick. It is very dark grayish brown, friable silt loam in the upper part and dark gray, friable silty clay loam in the lower part. It has many very dark gray worm casts. Below the subsoil is a buried surface layer of black clay loam about 7 inches thick and a buried subsoil of very dark gray and grayish brown, firm clay loam about 8 inches thick. Below this to a depth of about 60 inches is grayish brown, mottled loam. The soil is calcareous throughout.

The other soils in this map unit unit differ from the Bearden soil. On about 35 percent of the acreage of other soils, no buried horizon is evident. On about 20 percent, the surface layer is leached of free lime and is not likely to have a fertility imbalance. On about 35 percent, the solum dominantly is loamy. These areas generally are good sources of topsoil. On about 15 percent of the acreage of other soils, sandy material is at a depth of 40 to 60 inches. Crops in these areas show the effects of prolonged drought sooner than those in areas of the Bearden soil.

Included with these soils in mapping are small areas of Colvin and Malachy soils, which make up 5 to 15 percent of the unit. Colvin soils are in slightly lower areas. Available water capacity is lower in the Malachy soils than in the Bearden soil, and crops are affected by drought sooner.

Permeability is mostly moderate, and available water capacity is high. Surface runoff is slow to medium. The surface layer is mildly alkaline. The content of organic matter is high, the content of phosphorus is low, and the content of potassium is high. The seasonal high water table is at a depth of 3 to 5 feet in spring and during extended wet periods.

Most areas are cropped. These soils have good potential for cultivated crops, hay, and pasture and fair potential for windbreaks. They have fair or poor potential for most engineering uses.

If adequately fertilized, these soils are suited to all of the crops grown in the county. In places a high content of lime in the surface layer causes a fertility imbalance. This imbalance can be corrected by a liberal amount of potassium and phosphorus in fertilizers. The hazard of soil blowing is slight. Drainage is not needed in the areas of this unit, but managing this unit is easier if the adjoining soils are drained. Leaving crop residue on surface reduces the risk of soil blowing in fall-plowed fields during winter and spring.

The potential of these soils for the trees and shrubs needed in windbreaks is fair. An excessive content of lime affects the uptake of plant nutrients. Chlorosis, which results from a lack of iron, occurs in plants growing on these soils. This condition is best controlled by planting trees and shrubs that can tolerate the high content of lime. Soil blowing can be controlled by maintaining a mulch of crop residue. Grasses and weeds can be controlled in newly established windbreaks by shallow cultivation or approved herbicides.

The seasonal high water table affects many engineering uses. Septic tank absorption fields work poorly during wet periods when the water table is high. The high susceptibility to frost action on sites for roads and unheated buildings without basements can be overcome by removing surface water and by adding a cover of more suitable base material. Installing drainage tile on the outer side of the footings is one of the easiest methods of controlling the water table on sites for dwellings with basements. Capability subclass IIe; not assigned to a range site.

1810—Colvin complex. This map unit consists of nearly level, poorly drained, calcareous soils at the lower elevations on the lake plain and in overflow channels that lie between some of the streams that dissect the lowland plain. Most areas are subject to flooding. The original surface of the lake plain has been filled in and built up by deposits from overflowing streams. Areas are broad and range from 10 to more than 200 acres in size.

The Colvin soil makes up about 55 percent of this map unit. Typically, the surface layer is about 14 inches thick. It is black clay loam in the upper part and very dark gray and black silt loam in the lower part. The subsoil is about 19 inches thick. It is dark gray, mottled, friable loam in the upper part and dark gray and very dark gray, mottled, friable clay loam in the lower part. Below this is a buried surface layer that probably was the original surface of the lake plain. It is black silty clay loam about 11 inches thick. The underlying material to a depth of about 60 inches is gray, dark gray, and very dark gray, mottled silty clay loam. The soil is calcareous throughout.

The other soils in this map unit differ from the Colvin soil. On about 30 percent of the acreage of other soils, no buried horizon is evident. On about 30 percent, the surface layer is 20 to 36 inches thick. These soils generally are more productive than the Colvin soil. On about 20 percent of the acreage of other soils, the surface layer and subsoil contain more sand and the soil is easier to work. On about 15 percent, sandy material is 40 to 60 inches from the surface. On about 5 percent, the surface layer contains an excessive amount of gypsum and calcium, which adversely affects crop growth.

Included with these soils in mapping are small areas of Oldham silty clay and Bearden and Marysland soils, which make up 2 to 20 percent of the unit. The Oldham soil is more clayey than the Colvin soil and is harder to work. The Bearden soils are at slightly higher elevations than the Colvin soil and are better drained. The Marysland soils are underlain by sandy material. Special precautions are needed if excavations are made in these included areas.

Permeability is moderate or moderately slow in most of the soils in this map unit. Available water capacity is high, and surface runoff is slow. The surface layer is mildly alkaline or moderately alkaline. In places the soil contains an excessive amount of lime and, in some spots, an excessive amount of gypsum. The content of organic matter is high, the content of phosphorus is low, and the content of potassium is medium or high. The seasonal high water table is at a depth of 1 foot to 3 feet unless the soil has been artificially drained by drainage tiles.

Most areas are cropped. Some areas where more drainage is needed are used for grazing or wild hay. These soils have good potential for cultivated crops, fair to poor potential for windbreaks, and poor potential for most engineering uses.

These soils are suitable for intensive use if they are adequately drained and fertilized and if all crop residue is returned. They are flooded occasionally, especially by melt water during spring runoff. In places flooding after heavy rains during the growing season damages crops. The soils dry out and warm up slowly in spring. Tile is needed to provide subsurface drainage. If crop growth is poor after adequate drainage has been provided, a liberal amount of potassium and phosphorus is needed in fertilizers. These nutrients correct the fertility imbalance caused by the high content of lime. The ground water in places contains enough magnesium sulfate to disintegrate ordinary cement tile. Clay tile or alkali-resistant tile should be used. Fall plowing permits rapid preparation of a seedbed in spring.

The potential of these soils for the trees and shrubs needed in windbreaks is fair to poor. The wetness and the high content of lime reduce the number of species that can grow well. The excessive lime interferes with the uptake of nutrients in many woody plants. Chlorosis, which generally is caused by a deficiency of available iron, occurs in many trees and shrubs on soils that have a high content of lime. This condition is best controlled by planting trees and shrubs that can tolerate the lime content. Drainage lowers the seasonal high water table and favors deeper rooting. Site preparation should be completed during the fall before planting because in many years clods form if the soil is worked early in spring when it is too wet. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides.

These soils have poor potential for building site development primarily because of wetness and flooding. Artificial drainage and control of surface water are needed. Dwellings and small buildings should be designed to prevent the structural damage caused by frost action and by shrinking and swelling.

The wetness and the flood hazard limit the use of these soils as septic tank absorption fields, but in places a mound-type absorption field is suitable if surface water is controlled. A cover of suitable material is needed if local roads are to function properly. Also, surface water should be removed by adequately designed road ditches. Excavations are difficult and hazardous in the included areas of Marysland soils and in the soils that are underlain by sandy material at a depth of 40 inches or more. Excavations are easier in the fall or after dry periods when the water table is below the depth of excavation. Capability subclass IIw; not assigned to a range site.

1814—Oldham silty clay. This nearly level, poorly drained, calcareous soil is on low parts of the lake plain. In most areas it is flooded during snow melt in spring or after heavy rains. It has not been covered by sediments deposited by the streams that cross the lake plain. Slopes are slightly concave or plane. Individual areas range from 20 to 150 acres in size.

Typically, the surface layer is black silty clay about 17 inches thick. The subsoil is firm silty clay about 16 inches thick. It is black in the upper part and very dark gray in the lower part. The underlying material to a depth of about 46 inches is very dark gray and dark gray clay loam. Below this to a depth of about 60 inches is olive gray, mottled loam. The soil generally is calcareous throughout, but in a few areas the upper 10 inches is leached.

Included with this soil in mapping are areas of poorly drained Colvin soils, which make up 5 to 15 percent of the unit. These soils typically are covered by stream-deposited sediments and are less clayey than the Oldham soil.

Permeability is slow, surface runoff is very slow, and available water capacity is high. The surface layer is moderately alkaline. In some spots the soil contains an excessive amount of lime and gypsum. The shrink-swell potential is high. The content of organic matter and potassium is high, and the content of phosphorus is low. The seasonal high water table is at a depth of 1 foot to 3 feet in most places.

Most areas are cropped. The soil has good potential for cultivated crops and fair potential for pasture, hay, and windbreaks. It has poor potential for most engineering uses.

This soil is suited to all of the crops commonly grown in the county. Controlling wetness and soil blowing and maintaining good tilth on this clayey soil are the main problems of management. The soil is flooded occasionally, especially by melt water during spring runoff. In places flooding after heavy rains during the growing season damages crops. Tile drainage is needed to provide subsurface drainage. Alfalfa, sweet clover, and other deep-rooted legumes open channels in the clayey subsoil and help maintain adequate drainage. The soil dries out and warms up slowly in spring. Fall plowing permits rapid preparation of a seedbed in spring. Hard clods are likely to form if the soil is plowed or worked when wet. A rough surface and some crop residue on the surface reduce the risk of soil blowing. If crop growth is poor after adequate drainage has been provided, a liberal amount of potassium and phosphorus is needed in fertilizers. These nutrients help to correct the fertility imbalance caused by the high content of lime.

The potential of this soil for the trees and shrubs needed in windbreaks is fair. The wetness and high content of lime reduce the number of species that can grow well. The soil is too clayey for optimum growth of trees and shrubs. The excessive lime interferes with the uptake of nutrients in many woody plants. Chlorosis, which generally is caused by a deficiency of available iron, occurs in many trees and shrubs on soils that have a high content of lime. This condition is best controlled by planting trees and shrubs that can tolerate the lime content.

Drainage lowers the seasonal high water table and favors deeper rooting. Site preparation should be completed during the fall before planting because in many years clods form if the soil is worked early in spring when it is too wet. Weeds and grasses can be controlled in newly established windbreaks by shallow cultivation or approved herbicides.

Because of the wetness, the occasional flooding, the high shrink-swell potential, and the slow permeability, this soil is undesirable for most engineering uses. The wetness, the flooding, and the slow permeability limit the use for most sanitary facilities, but the soil has good potential for sewage lagoons if flooding can be controlled. A suitable base material is needed if local roads are to function properly. Capability subclass IIw; not assigned to a range site.

Use and management of the soils

The soil survey is a detailed inventory and evaluation of the most basic resource of the survey area—the soil. It is useful in adjusting land use, including urbanization, to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in uses of the land.

While a soil survey is in progress, soil scientists, conservationists, engineers, and others keep extensive notes about the nature of the soils and about unique aspects of behavior of the soils. These notes include data on erosion, drought damage to specific crops, yield estimates, flooding, the functioning of septic tank disposal systems, and other factors affecting the productivity, potential, and limitations of the soils under various uses and management. In this way, field experience and measured data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section is useful in planning use and management of soils for crops and pasture, rangeland, and woodland, as sites for buildings, highways and other transportation systems, sanitary facilities, and parks and other recreation facilities, and for wildlife habitat. From the data presented, the potential of each soil for specified land uses can be determined, soil limitations to these land uses can be identified, and costly failures in houses and other structures, caused by unfavorable soil properties, can be avoided. A site where soil properties are favorable can be selected, or practices that will overcome the soil limitations can be planned.

Planners and others using the soil survey can evaluate the impact of specific land uses on the overall productivity of the survey area or other broad planning area and on the environment. Productivity and the environment are closely related to the nature of the soil. Plans should maintain or create a land-use pattern in harmony with the natural soil.

Contractors can find information that is useful in locating sources of sand and gravel, roadfill, and topsoil. Other information indicates the presence of bedrock, wetness, or very firm soil horizons that cause difficulty in excavation.

Health officials, highway officials, engineers, and many other specialists also can find useful information in this soil survey. The safe disposal of wastes, for example, is closely related to properties of the soil. Pavements, sidewalks, campsites, playgrounds, lawns, and trees and shrubs are influenced by the nature of the soil.

Crops and pasture

Larry A. Schmidt, district conservationist, Soil Conservation Service, helped prepare this section.

The major management concerns in the use of the soils for crops and pasture are described in this section. In addition, the crops or pasture plants best suited to the soil, including some not commonly grown in the survey area, are discussed; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are presented for each soil.

This section provides information about the overall agricultural potential of the survey area and about the management practices that are needed. The information is useful to equipment dealers, land improvement contractors, fertilizer companies, processing companies, planners, conservationists, and others. For each kind of soil, information about management is presented in the section "Soil maps for detailed planning." Planners of management systems for individual fields or farms should also consider the detailed information given in the description of each soil.

More than 405,000 acres in the county was cropland and pasture in 1967, according to the Minnesota Soil and Water Conservation Needs Inventory. Of this total, 218,000 acres was used for row crops, mainly corn and soybeans; 48,000 acres for close-grown crops, mainly oats, flax, and wheat; 46,000 acres for rotation hay and pasture; and 45,000 acres for permanent pasture. The rest was idle cropland.

The potential of the soils in Lyon County for increased production of food is good. About 27,000 acres of potentially good cropland is currently used as pasture. In addition to the reserve productive capacity represented by this land, food production could also be increased considerably by extending the latest crop production technology to all cropland in the county. This soil survey can greatly facilitate the application of such technology.

The acreage in crops and pasture is gradually decreasing as more and more land is used for urban development. In 1967, an estimated 18,000 acres of urban and built-up land was in the county. The acreage of such land has been growing at the rate of about 500 acres per year. This soil survey can help planners to make land-use decisions that will influence the future role of farming in the county.

Soil erosion is a major problem on about half of the cropland in Lyon County. It is a hazard on the undulating and steeper soils. Barnes, Everly, Forman, Poinsett, Storden, and Ves soils are examples.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Erosion is especially damaging on soils in which the root zone is limited and available water capacity is low or moderate, such as Arvilla, Fordville, and Sverdrup soils. Second, soil erosion on farmland results in sediment entering streams. Control of erosion minimizes the pollution of streams by sediment and improves the quality of water for recreation and for fish and wildlife.

Erosion control provides protective surface cover, reduces runoff, and increases the infiltration rate. A cropping system that keeps a plant cover on the soil for extended periods can hold soil erosion losses to an amount that will not reduce the productive capacity of the soils. On livestock farms, which require pasture and hay, legume and grass forage crops in the cropping system reduce the risk of erosion on sloping soils and provide nitrogen and improve tilth for the following crop.

Slopes are so short and irregular that contour tillage or terracing is difficult in most areas of Barnes, Buse, Storden, and Ves soils. In some areas of these soils, cut and fill terraces can be used. In most, a cropping system that provides substantial plant cover is needed to control erosion unless tillage is kept to a minimum. Minimizing tillage and leaving crop residue on the surface increase the infiltration rate and reduce the hazards of runoff and erosion. They can be adapted to most soils in the survey area.

Terraces and diversions reduce the length of slopes and the hazards of runoff and erosion. They are most practical on deep, well drained soils that have regular slopes. Everly, Forman, Buse, and Poinsett soils are suitable for terraces. The other soils are less suitable for terraces and diversions because of irregular slopes; steep slopes; excessive wetness in the terrace channels; a sandy subsoil, which would be exposed in terrace channels; or sand and gravel within a depth of 40 inches.

Contouring and contour stripcropping are other erosion-control measures used in the survey area (fig. 13). They are best adapted to soils with regular slopes.

Soil blowing is a hazard on the Arvilla and Sverdrup sandy loams and the Oldham, Fulda, and Sinai silty clays. It can damage these soils in a few hours if winds are strong and soils are dry and bare of vegetation or surface mulch. Maintaining plant cover and surface mulch or keeping the surface rough through proper tillage minimizes soil blowing on these soils. All of the soils in the county can be damaged by soil blowing, especially after soybeans are grown. Windbreaks of suitable shrubs and trees, such as Tatarian honeysuckle and green ash, are effective in reducing the risk of soil blowing on sandy and clayey soils.

Information about the design of erosion-control practices for each kind of soil is contained in the Technical Guide, available in local offices of the Soil Conservation Service.

Soil drainage is the major management need on about a third of the acreage used for crops in the county. Some soils are naturally so wet that the production of the crops commonly grown in the area is generally not possible unless artificial drainage has been provided. These are the very poorly drained Glencoe, Oldham, Quam, Rolfe, Rauville, and Urness soils, which make up about 27,900 acres.

Unless artificially drained, poorly drained soils are so wet that crops are damaged during most years. Oldham silty clay and Canisteo, Colvin, Flom, Fulda, Lamoure, Marysland, Vallers, and Letri soils are poorly drained. They make up about 126,500 acres.

Small areas of the wetter soils along drainageways and in swales are commonly included in areas of the moderately well drained Aastad, Wilmonton, Sinai, Svea, and Normania soils. Artificial drainage is needed in some of these areas.

The design of surface and subsurface drainage systems varies with the kind of soil. A combination of surface drainage and tile drainage is needed in most areas of the poorly drained and very poorly drained soils used for intensive row cropping. Tile drain lines should be more closely spaced in slowly permeable soils than they are in the more permeable soils. Tile drainage is slow in Fulda, Rolfe, and Oldham soils. Finding adequate outlets for tile drainage systems is difficult in many areas of Colvin, Lamoure, and Rauville soils.

Information about the design of drainage systems for each kind of soil is contained in the Technical Guide, available in local offices of the Soil Conservation Service.

Soil fertility is naturally medium or high in most soils in the county. All but the Rolfe soils are naturally neutral or alkaline. Rolfe soils are medium acid or slightly acid.

Crops on most of the soils in the county respond to applications of fertilizer. The need for fertilizer specified in the descriptions of soils under the heading "Soil maps for detailed planning" refers to that of the subsoil. The soils are especially low in phosphorus. The need for fertilizer depends on the kind of soil, past and present management, and the kind of crop that is grown. Soil tests provide part of the information that is needed in choosing the proper kinds and amounts of fertilizer.

Applications of fertilizer and organic matter generally improve plant growth in areas of the poorly drained, somewhat poorly drained, and moderately well drained soils in which excess lime causes a fertility imbalance. Examples of poorly drained soils are Canisteo, Colvin, and Vallers soils and of the moderately well drained and somewhat poorly drained soils are Bearden, Hamerly, and Seaforth soils.

Soil tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils with good tilth are granular and porous. Regular additions of crop residue, manure, and other organic matter can improve soil structure and the infiltration rate.

Fall plowing is generally not a good practice if soil blowing is a hazard, if, on the sloping and steeper soils, the erosion hazard is severe, or if soybeans are grown.

Many soils in the county are wet or are intermingled with wet soils. Poor tilth is a problem because the soils often stay wet until late in spring. If the soils are wet when plowed, they tend to be very cloddy when dry, and good seedbeds are difficult to prepare. Fall plowing generally results in good tilth in spring.

Field crops suited to the soils and climate of the county include many that are not now commonly grown. Corn and soybeans are the row crops. Grain sorghum, sunflowers, beans, sugar beets, and similar crops can be grown if economic conditions are favorable.

Oats, wheat, and flax are the most common close-growing crops. Rye, barley, and buckwheat could be grown, and grass seed could be produced from bromegrass, big bluestem, switchgrass, and Indiangrass. Alfalfa, sweet clover, and red clover also could be harvested for seed.

Special crops grown in the county are vegetables, small fruit, tree fruit, and nursery plants. They mostly are grown by home gardeners and in the few small commercial gardens in the county. Most vegetables and fruits grow well on soils that have good natural drainage, warm up early in spring, and are protected. Supplemental water should be available. The latest information about growing special crops can be obtained from local offices of the Agricultural Extention Service and the Soil Conservation Service.

Yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 4. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. Absence of an estimated yield indicates that the crop is not suited to or not commonly grown on the soil.

The estimated yields were based mainly on the experience and records of farmers, conservationists, and extension agents. Results of field trials and demonstrations and available yield data from nearby counties were also considered.

The yields were estimated assuming that the latest soil and crop management practices were used. Hay and pasture yields were estimated for the most productive varieties of grasses and legumes suited to the climate and the soil. A few farmers may be obtaining average yields higher than those shown in table 4.

The management needed to achieve the indicated yields of the various crops depends on the kind of soil and the crop. Such management provides drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate tillage practices, including time of tillage and seedbed preparation and tilling when soil moisture is favorable; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residues, barnyard manure, and green-manure crops; harvesting crops with the smallest possible loss; and timeliness of all fieldwork.

The estimated yields reflect the productive capacity of the soils for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 4 are grown in the survey area, but estimated yields are not included because the acreage of these crops is small. The local offices of the Soil Conservation Service and the Agricultural Extension Service can provide information about the management concerns and productivity of the soils for these crops.

Capability classes and subclasses

Capability classes and subclasses show, in a general way, the suitability of soils for most kinds of field crops. The soils are classed according to their limitations when they are used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for forest trees, or for engineering purposes.

In the capability system, all kinds of soil are grouped at two levels: capability class and subclass. These levels are defined in the following paragraphs. A survey area may not have soils of all classes.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and landforms have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability subclass is identified in the description of each soil map unit in the section "Soil maps for detailed planning."

Rangeland

ELDOR P. MUELLER, conservation agronomist, Soil Conservation Service, helped prepare this section.

Rangeland makes up less than 10 percent of Lyon County. It occurs mostly as small tracts within farmed areas. These tracts are on the Altamont moraine and the Coteau slope. Some of the larger areas are hilly, are along streams, or are sandy and gravelly. The grazing animals are stock cows and calves and yearlings.

The native vegetation on many parts of the rangeland has been greatly depleted by excessive grazing. Much of the acreage that once was open grassland is now covered with Kentucky bluegrass, weeds, and brush. The amount of forage produced may be less than half that originally produced. Productivity of the range can be increased by using management that is effective for specific kinds of soil and range sites.

Where climate and topography are about the same, differences in the kind and amount of vegetation that rangeland can produce are related closely to the kind of soil. Effective management is based on the relationships among soils, vegetation, and water.

Table 5 shows, for each kind of soil, the name of the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the expected percentage of each species in the composition of the potential natural plant community. Soils not listed cannot support a natural plant community of predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. The following are explanations of column headings in table 5.

A *range site* is a distinctive kind of rangeland that differs from other kinds of rangeland in its ability to produce a characteristic natural plant community. Soils that produce a similar kind, amount, and proportion of range plants are grouped into range sites. For those areas where the relationship between soils and vegetation has been established, range sites can be interpreted directly from the soil map. Properties that determine the capacity of the soil to supply moisture and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production refers to the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year the amount and distribution of precipitation and the temperatures are such that growing conditions are substantially better than average; in a normal year these conditions are about average for the area; in an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight refers to the total air-dry vegetation produced per acre each year by the potential natural plant community. Vegetation that is highly palatable to livestock and vegetation that is unpalatable are included. Some of the vegetation can also be grazed extensively by wildlife.

Characteristic species of grasses, grasslike plants, forbs, and shrubs that make up most of the potential natural plant community on each soil are listed by common name. Under *Composition*, the expected proportion of each species is presented as the percentage, in air-dry weight, of the total annual production of herbaceous and woody plants. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season. Generally all of the vegetation produced is not used.

Range management requires, in addition to knowledge of the kinds of soil and the potential natural plant community, an evaluation of the present condition of the range vegetation in relation to its potential. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the maximum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Windbreaks and environmental plantings

Windbreaks are established to protect livestock, buildings, and yards from wind and snow. Windbreaks also help protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-grow-

ing broad-leaved and coniferous species provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field, the interval depending on erodibility of the soil. They protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. A healthy planting stock of suitable species planted properly on a well prepared site and maintained in good condition can insure a high degree of plant survival.

Table 6 shows the height that locally grown trees and shrubs are expected to reach on various kinds of soil in 20 years. The estimates in table 6, based on measurements and observation of established plantings that have been given adequate care, can be used as a guide in planning windbreaks and screens. Additional information about planning windbreaks and screens and the planting and care of trees can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from nurserymen.

Engineering

Clarence P. Simonsen, engineer, Soil Conservation Service, helped prepare this section.

This section provides information about the use of soils for building sites, sanitary facilities, construction material, and water management. Among those who can benefit from this information are engineers, landowners, community planners, town and city managers, land developers, builders, contractors, and farmers and ranchers.

The ratings in the engineering tables are based on test data and estimated data in the "Soil properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

Among the soil properties and site conditions identified by a soil survey and used in determining the ratings in this section were grain-size distribution, liquid limit, plasticity index, soil reaction, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density, and geologic origin of the soil material. Where pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

On the basis of information assembled about soil properties, ranges of values can be estimated for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values can be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems, and other engineering works. The ranges of values can be used to (1) select potential residential, commercial, industrial, and recreational uses; (2) make preliminary estimates pertinent to construction in a particular area; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; (5) plan detailed onsite investigations of soils and geology; (6) find sources of gravel, sand, clay, and topsoil; (7) plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; (8) relate performance of structures already built to the properties of the kinds of soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted; and (9) predict the trafficability of soils for cross-country movement of vehicles and construction equipment.

Data presented in this section are useful for land-use planning and for choosing alternative practices or general designs that will overcome unfavorable soil properties and minimize soil-related failures. Limitations to the use of these data, however, should be well understood. First, the data are generally not presented for soil material below a depth of 5 or 6 feet. Also, because of the scale of the detailed map in this soil survey, small areas of soils that differ from the dominant soil may be included in mapping. Thus, these data do not eliminate the need for onsite investigations, testing, and analysis by personnel having expertise in the specific use contemplated.

The information is presented mainly in tables. Table 7 shows, for each kind of soil, the degree and kind of limitations for building site development; table 8, for sanitary facilities. Table 10 shows the kind of limitations for water management. Table 9 shows the suitability of each kind of soil as a source of construction materials.

The information in the tables, along with the soil map, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations and to construct interpretive maps for specific uses of land.

Some of the terms used in this soil survey have a special meaning in soil science. Many of these terms are defined in the Glossary.

Building site development

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets are indicated in table 7. A *slight* limitation indicates that soil properties generally are favorable for the specified use; any limitation is minor and easily overcome. A

moderate limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A *severe* limitation indicates that one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils rated severe, such costly measures may not be feasible.

Shallow excavations are made for pipelines, sewerlines, communications and power transmission lines, basements, and open ditches. Such digging or trenching is influenced by soil wetness caused by a seasonal high water table; the texture and consistence of soils; the tendency of soils to cave in or slough; and the presence of very firm, dense soil layers, bedrock, or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 6 feet unless otherwise noted.

In the soil series descriptions, the consistence of each soil horizon is given, and the presence of very firm or extremely firm horizons, usually difficult to excavate, is indicated.

Dwellings and *small commercial buildings* referred to in table 7 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence of the structure from settling or shear failure of the foundation does not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, potential frost action, soil wetness, and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns, and gardens. Depth to bedrock, slope, and large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious hazard.

Local roads and streets referred to in table 7 have an all-weather surface that can carry light to medium traffic all year. They consist of a subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The classifications of the soil and the soil texture, density, shrink-swell potential, and potential frost action are indicators of the traffic supporting capacity used in making the ratings. Soil wetness, flooding, slope, depth to hard rock or very compact layers, and content of large stones affect stability and ease of excavation.

Sanitary facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that affect ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 8 shows the degree and kind of limitations of each soil for such uses and for use of the soil as daily cover for landfills. It is important to observe local ordinances and regulations.

If the degree of soil limitation is expressed as *slight*, soils are generally favorable for the specified use and limitations are minor and easily overcome; if *moderate*, soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if *severe*, soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance is required. Soil suitability is rated by the terms *good*, *fair*, or *poor*, which, respectively, mean about the same as the terms *slight*, *moderate*, and *severe*.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 18 and 72 inches are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect absorption of the effluent are permeability, depth to seasonal high water table, and susceptibility to flooding. Stones and boulders interfere with installation. Excessive slope can cause lateral seepage and surfacing of the effluent. Also, soil erosion and soil slippage are hazards if absorption fields are installed on sloping soils.

In some soils, loose sand and gravel are less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and ground water in the area may be contaminated.

On many of the soils that have moderate or severe limitations for use as septic tank absorption fields, a system to lower the seasonal water table can be installed or the size of the absorption field can be increased so that performance is satisfactory.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons have a nearly level floor and cut slopes or embankments of compacted soil material. Aerobic lagoons generally are designed to hold sewage within a depth of 2 to 5 feet. Nearly impervious soil material for

the lagoon floor and sides is required to minimize seepage and contamination of ground water. Soils that are very high in content of organic matter and those that have cobbles, stones, or boulders are not suitable. Unless the soil has very slow permeability, contamination of ground water is a hazard where the seasonal high water table is above the level of the lagoon floor. In soils where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce the lagoon's capacity for liquid waste. Slope and susceptibility to flooding also affect the suitability of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soil material affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste by placing refuse in successive layers either in excavated trenches or on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil material. Landfill areas are subject to heavy vehicular traffic. Risk of polluting ground water and trafficability affect the suitability of a soil for this use. The best soils have a loamy or silty texture, have moderate to slow permeability, are deep to a seasonal water table, and are not subject to flooding. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability, which might allow noxious liquids to contaminate ground water. Soil wetness can be a limitation, because operating heavy equipment on a wet soil is difficult. Seepage into the refuse increases the risk of pollution of ground water.

Ease of excavation affects the suitability of a soil for the trench type of landfill. A suitable soil is deep to bedrock and free of large stones and boulders. If the seasonal water table is high, water will seep into trenches.

Unless otherwise stated, the limitations in table 8 apply only to the soil material within a depth of about 6 feet. If the trench is deeper, a limitation of slight or moderate may not be valid. Site investigation is needed before a site is selected.

Daily cover for landfill should be soil that is easy to excavate and spread over the compacted fill in wet and dry periods. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

The soils selected for final cover of landfills should be suitable for growing plants. Of all the horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

Where it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas. These factors include slope, erodibility, and potential for plant growth.

Construction materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 9 by ratings of good, fair, or poor. The texture, thickness, and organic-matter content of each soil horizon are important factors in rating soils for use as construction materials. Each soil is evaluated to the depth observed, generally about 6 feet.

Roadfill is soil material used in embankments for roads. Soils are evaluated as a source of roadfill for low embankments, which generally are less than 6 feet high and less exacting in design than high embankments. The ratings reflect the ease of excavating and working the material and the expected performance of the material where it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about some of the soil properties that influence such performance is given in the descriptions of the soil series.

The ratings apply to the soil material between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within their profile. The estimated engineering properties in table 13 provide specific information about the nature of each horizon. This information can help determine the suitability of each horizon for roadfill.

Soils rated *good* are coarse grained. They have low shrink-swell potential, low potential frost action, and few cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated *fair* have a plasticity index of less than 15 and have other limiting features, such as moderate shrink-swell potential, moderately steep slopes, wetness, or many stones. If the thickness of suitable material is less than 3 feet, the entire soil is rated *poor*.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 9 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 13.

Topsoil is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material

to support plantlife. Also considered is the damage that can result at the area from which the topsoil is taken.

The ease of excavation is influenced by the thickness of suitable material, wetness, slope, and amount of stones. The ability of the soil to support plantlife is determined by texture, structure, and the amount of soluble salts or toxic substances. Organic matter in the A1 or Ap horizon greatly increases the absorption and retention of moisture and nutrients. Therefore, the soil material from these horizons should be carefully preserved for later use.

Soils rated *good* have at least 16 inches of friable loamy material at their surface. They are free of stones and cobbles, are low in content of gravel, and have gentle slopes. They are low in soluble salts that can limit or prevent plant growth. They are naturally fertile or respond well to fertilizer. They are not so wet that excavation is difficult during most of the year.

Soils rated *fair* are loose sandy soils or firm loamy or clayey soils in which the suitable material is only 8 to 16 inches thick or soils that have appreciable amounts of gravel, stones, or soluble salt.

Soils rated *poor* are very sandy soils and very firm clayey soils; soils with suitable layers less than 8 inches thick; soils having large amounts of gravel, stones, or soluble salt; steep soils; and poorly drained soils.

Although a rating of *good* is not based entirely on high content of organic matter, a surface horizon is generally preferred for topsoil because of its organic-matter content. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter.

Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 10 soil and site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water-control structures.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have a low seepage potential, which is determined by permeability and the depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping and has favorable stability, shrink-swell potential, shear strength, and compaction characteristics. Large stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes, and levees.

Aquifer-fed excavated ponds are bodies of water made by excavating a pit or dugout into a ground-water aquifer. Excluded are ponds that are fed by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Ratings in table 10 are for ponds that are properly designed, located, and constructed. Soil properties and site features that affect aquifer-fed ponds are depth to a permanent water table, permeability of the aquifer, quality of the water, and ease of excavation.

Drainage of soil is affected by such soil properties as permeability; texture; depth to bedrock, hardpan, or other layers that affect the rate of water movement; depth to the water table; slope; stability of ditchbanks; susceptibility to flooding; salinity and alkalinity; and availability of outlets for drainage.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to intercept runoff. They allow water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock, hardpan, or other unfavorable material; large stones; permeability; ease of establishing vegetation; and resistance to water erosion, soil blowing, soil slipping, and piping.

Grassed waterways are constructed to channel runoff to outlets at a nonerosive velocity. Features that affect the use of soils for waterways are slope, permeability, erodibility, wetness, and suitability for permanent vegetation.

Recreation

The major recreational areas in the county are Camden State Park, along the Redwood River, and Garvin County Park, along the Cottonwood River. All of the towns have community parks. The potential for development of recreational areas is fair. Areas along the shoreline of some of the lakes can be further developed, and the State and county park systems can be expanded.

The soils of the survey area are rated in table 11 according to limitations that affect their suitability for recreation uses. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreation use by the duration and intensity of flooding and the season when flooding occurs. Onsite assessment of height, duration, intensity, and frequency of flooding is essential in planning recreation facilities.

The degree of the limitation of the soils is expressed as slight, moderate, or severe. *Slight* means that the soil properties are generally favorable and that the limitations are minor and easily overcome. *Moderate* means that the limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 11 can be supplemented by information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 8, and interpretations for dwellings without basements and for local roads and streets, given in table 7.

Camp areas require such site preparation as shaping and leveling for tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils for this use have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing camping sites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for use as picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that will increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones or boulders, is firm after rains, and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth to gravel or to a hardpan should be enough to allow necessary grading.

Paths and trails for walking, horseback riding, bicycling, and other uses should require little or no cutting and filling. The best soils for this use are those that are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once during the annual period of use. They should have moderate slopes and have few or no stones or boulders on the surface.

Wildlife habitat

The soils of Lyon County can provide good habitat for various species of wildlife. Changes in the land-use pattern, however, have directly affected the population of wildlife species. For example, Lyon County once had a high population of pheasants, but more intensive farming has severely reduced the population. Other small game are Hungarian partridge, rabbit, squirrel, fox, and beaver.

Duck production occurs near the permanent marshes, most of which are in 38 wildlife management units, totaling over 7,500 acres, that are owned by the State and in areas near some of the 335 ponds and pits that have been constructed. Lyon County is on the migration route of ducks and geese.

The wooded valleys along the major rivers have a good deer population. Bullheads and carp are in most of the lakes, which generally are shallow. Northern pike, walleye, crappie, and perch are caught in some of the larger lakes. About 45 farm ponds and Brawner Lake, which is a State-owned artificial lake, have been stocked with sunfish or crappies and bass. The Redwood River, near Camden State Park, is stocked annually with brown trout.

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the construction of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, is inadequate, or is inaccessible, wildlife either are scarce or do not inhabit the area.

If the soils have the potential, wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by helping the natural establishment of desirable plants.

In table 12, the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in planning for parks, wildlife refuges, nature study areas, and other developments for wildlife; selecting areas that are suitable for wildlife; selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat; and determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* means that the element of wildlife habitat or the kind of habitat is easily created, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of wildlife are very severe, and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

The elements of wildlife habitat are briefly described in the following paragraphs.

Grain and seed crops are seed-producing annuals used by wildlife. The major soil properties that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Major soil properties that affect the growth of grasses and legumes are depth of the root zone, texture

of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, bluegrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. Major soil properties that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, fescue, and grama.

Hardwood trees and the associated woody understory provide cover for wildlife and produce nuts or other fruit, buds, catkins, twigs, bark, or foliage that wildlife eat. Major soil properties that affect growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of native plants are oak, chokecherry, ash, hawthorn, dogwood, wild plum, maple, basswood, raspberry, black walnut, grape, viburnum, and willow. Examples of fruit-producing shrubs that are commercially available and suitable for planting on soils rated *good* are Russian-olive, honeysuckle, cherry, and crabapple.

Coniferous plants are cone-bearing trees, shrubs, or ground cover plants that furnish habitat or supply food in the form of browse, seeds, or fruitlike cones. Soil properties that have a major effect on the growth of coniferous plants are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, saltgrass, and cordgrass and rushes, sedges, and reeds.

Shallow water areas are bodies of water that have an average depth of less than 5 feet and that are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water-control structures in marshes or streams. Major soil properties affecting shallow water areas are wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The kinds of wildlife habitat are briefly described in the following paragraphs.

Openland habitat consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The kinds of wildlife attracted to these areas include Hungarian partridge, pheasant, meadowlark, field sparrow, mourning dove, cottontail rabbit, and red fox.

Woodland habitat consists of areas of hardwoods or conifers, or a mixture of both, and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include thrushes, woodpeckers, squirrels, fox, raccoon, and deer.

Wetland habitat consists of open, marshy or swampy, shallow water areas where water-tolerant plants grow. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Soil properties

Extensive data about soil properties are summarized on the following pages. The two main sources of these data are the many thousands of soil borings made during the course of the survey and the laboratory analyses of selected soil samples from typical profiles.

In making soil borings during field mapping, soil scientists can identify several important soil properties. They note the seasonal soil moisture condition or the presence of free water and its depth. For each horizon in the profile, they note the thickness and color of the soil material; the texture, or amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or the natural pattern of cracks and pores in the undisturbed soil; and the consistence of the soil material in place under the existing soil moisture conditions. They record the depth of plant roots, determine the pH or reaction of the soil, and identify any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to determine all major properties of key soils, especially properties that cannot be estimated accurately by field observation. Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many soil series not tested are available from nearby survey areas.

The available field and laboratory data are summarized in tables. The tables give the estimated range of engineering properties, the engineering classifications, and the physical and chemical properties of each major horizon of each soil in the survey area. They also present data about pertinent soil and water features and engineering test data.

Engineering properties

Table 13 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Table 13 gives information for each of these contrasting horizons in a typical profile. *Depth* to the upper and lower boundaries of each horizon

is indicated. More information about the range in depth and about other properties in each horizon is given for each soil series in the section "Soil series and morphology."

Texture is described in table 13 in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified Soil Classification System (Unified) (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO) (*1*).

The *Unified* system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example, CL-ML.

The *AASHTO* system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines. At the other extreme, in group A-7, are fine-grained soils. Highly organic soils are classified in group A-8 on the basis of visual inspection.

When laboratory data are available, the A-1, A-2, and A-7 groups are further classified as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested in the survey area is given in table 16. The estimated classification for all of the soils in the survey area is given in table 13. Also in table 13 the percentage, by weight, of rock fragments more than 3 inches in diameter is estimated for each major horizon. These estimates are determined mainly by observing volume percentage in the field and then converting that, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four sieves (U.S. standard) is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and *plasticity index* indicate the effect of water on the strength and consistence of soil. These indexes are used in both the Unified and AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior. Range in liquid limit and plasticity index are estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

In some surveys, the estimates are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterburg limits extend a marginal amount across classification boundaries (1 or 2 percent), the classification in the marginal zone is omitted.

Physical and chemical properties

Table 14 shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the typical pedon of each soil. The estimates are based on field observations and on test data for these and similar soils.

Permeability is estimated on the basis of known relationships among the soil characteristics observed in the field—particularly soil structure, porosity, and gradation or texture—that influence the downward movement of water in the soil. The estimates are for vertical water movement when the soil is saturated. Not considered in the estimates is lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in planning and designing drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed as a range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops, ornamental plants, or other plants to be grown; in evaluating soil amendments for fertility and stabilization; and in evaluating the corrosivity of soils.

Salinity is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25

degrees C. Estimates are based on field and laboratory measurements at representative sites of the nonirrigated soils. The salinity of individual irrigated fields is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of individual fields can differ greatly from the value given in table 14. Salinity affects the suitability of a soil for crop production, its stability when used as a construction material, and its potential to corrode metal and concrete.

Shrink-swell potential depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others the swelling was estimated on the basis of the kind and amount of clay in the soil and on measurements of similar soils. The size of the load and the magnitude of the change in soil moisture content also influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used. A high shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

Risk of corrosion pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil material. The rate of corrosion of concrete is based mainly on the sulfate content, texture, and acidity of the soil. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Uncoated steel intersecting soil boundaries or soil horizons is more susceptible to corrosion than an installation that is entirely within one kind of soil or within one soil horizon.

Erosion factors are used to predict the erodibility of a soil and its tolerance to erosion in relation to specific kinds of land use and treatment. The soil erodibility factor (K) is a measure of the susceptibility of the soil to erosion by water. Soils having the highest K values are the most erodible. K values range from 0.10 to 0.64. To estimate annual soil loss per acre, the K value of a soil is modified by factors representing plant cover, grade and length of slope, management practices, and climate. The soil-loss tolerance factor (T) is the maximum rate of soil erosion, whether from rainfall or soil blowing, that can occur without reducing crop production or environmental quality. The rate is expressed in tons of soil loss per acre per year.

Wind erodibility groups are made up of soils that have similar properties that affect their resistance to soil blowing if cultivated. The groups are used to predict the susceptibility of soil to blowing and the amount of soil lost as a result of blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are extremely erodible, so vegetation is difficult to establish. They are generally not suitable for crops.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible, but crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible, but crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible, but crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible, but crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible, but crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible, and crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible, and crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Soil and water features

Table 15 contains information helpful in planning land uses and engineering projects that are likely to be affected by soil and water features.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist chiefly of deep, well drained to excessively drained sands or gravels. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils that have a layer that impedes the downward movement of water or soils that have moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clay soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding is the temporary covering of soil with water from overflowing streams, with runoff from adjacent slopes, and by tides. Water standing for short periods after rains or after snow melts is not considered flooding, nor is water in swamps and marshes. Flooding is rated in general terms that describe the frequency and duration of flooding and the time of year when flooding is most likely. The ratings are based on evidence in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; and absence of distinctive soil horizons that form in soils of the area that are not subject to flooding. The ratings are also based on local information about floodwater levels in the area and the extent of flooding and on information that relates the position of each soil on the landscape to historic floods.

The generalized description of flood hazards is of value in land-use planning and provides a valid basis for land-use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table is the highest level of a saturated zone more than 6 inches thick for a continuous period of more than 2 weeks during most years. The depth to a seasonal high water table applies to undrained soils. Estimates are based mainly on the relationship between grayish colors or mottles in the soil and the depth to free water observed in many borings made during the course of the soil survey. Indicated in table 15 are the depth to the seasonal high water table; the kind of water table, that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. Only saturated zones above a depth of 5 or 6 feet are indicated.

Information about the seasonal high water table helps in assessing the need for specially designed foundations, the need for specific kinds of drainage systems, and the need for footing drains to insure dry basements. Such information is also needed to decide whether or not construction of basements is feasible and to determine how septic tank absorption fields and other underground installations will function. Also, a seasonal high water table affects ease of excavation.

Potential frost action refers to the likelihood of damage to pavements and other structures by frost heaving and low soil strength after thawing. Frost action results from the movement of soil moisture into the freezing temperature zone in the soil, which causes ice lenses to form. Soil texture, temperature, moisture content, porosity, permeability, and content of organic matter are the most important soil properties that affect frost action. It is assumed that the soil is not covered by insulating vegetation or snow and is not artificially drained. Silty and clayey soils that have a high water table in winter are most susceptible to frost action. Well drained very gravelly or sandy soils are the least susceptible.

Engineering test data

The results of analyses of engineering properties of several typical soils of the survey area are given in table 16.

The data presented are for soil samples that were collected from carefully selected sites. The soil profiles sampled are typical of the series discussed in the section "Soil series and morphology." The soil samples were analyzed by the State of Minnesota, Department of Highways.

The methods used in obtaining the data are listed by code in the next paragraph. Most of the codes, in parentheses, refer to the methods assigned by the American Association of State Highway and Transportation Officials. The code for Unified classification is that assigned by the American Society for Testing and Materials.

The methods and codes are AASHTO classification (M-145-66); Unified classification (D-2487-69); mechanical analysis (T88-57); liquid limit (T89-60); plasticity index (T90-56); and moisture-density, method A (T99-57).

Soil series and morphology

In this section, each soil series recognized in the survey area is described in detail. The descriptions are arranged in alphabetic order by series name.

Characteristics of the soil and the material in which it formed are discussed for each series. The soil is then compared to similar soils and to nearby soils of other series. Then a pedon, a small three-dimensional area of soil that is typical of the soil series in the survey area, is described. The detailed descriptions of each soil horizon follow standards in the Soil Survey Manual (*7*). Unless otherwise noted, colors described are for moist soil.

Following the pedon description is the range of important characteristics of the soil series in this survey area. Phases, or map units, of each soil series are described in the section "Soil maps for detailed planning."

Aastad series

The Aastad series consists of moderately well drained soils that are moderately slowly permeable. These soils

formed in moderately fine textured glacial till on uplands. Slope ranges from 0 to 2 percent.

Aastad soils are similar to Svea soils and are adjacent to Forman and Flom soils. Svea soils contain less clay in the control section than Aastad soils. Forman soils have a thinner A horizon than Aastad soils, are browner in the B horizon, are more sloping, and are on slightly higher parts of the landscape. Flom soils have lower chroma in the B horizon than Aastad soils and are wetter.

Typical pedon of Aastad clay loam, 0 to 2 percent slopes, 200 feet north and 200 feet west of the southeast corner of SW1/4 sec. 33, T. 111 N., R. 41 W.

Ap—0 to 9 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) crushed; weak very fine and fine subangular blocky structure; friable; about 3 percent coarse fragments; neutral; abrupt smooth boundary.

A3—9 to 12 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) crushed; moderate very fine and medium subangular blocky structure; friable; few very dark gray (10YR 3/1) worm casts; about 4 percent coarse fragments; neutral; clear irregular boundary.

B2—12 to 19 inches; dark olive brown (2.5Y 3/3) clay loam; moderate fine and medium subangular blocky structure parting to moderate fine and medium subangular blocky; firm; few very dark brown (10YR 2/2) worm casts; about 4 percent coarse fragments; mildly alkaline; abrupt wavy boundary.

B3gca—19 to 28 inches; light olive brown (2.5Y 5/4) clay loam; common fine faint grayish brown (2.5Y 5/2) mottles; weak coarse prismatic structure parting to weak fine and medium subangular blocky; friable; few black (10YR 2/1) worm casts; common soft lime masses; about 10 percent coarse fragments; violent effervescence; moderately alkaline; gradual smooth boundary.

C1g—28 to 60 inches; grayish brown (2.5Y 5/2) clay loam; common medium prominent yellowish brown (10YR 5/6) and brownish yellow (10YR 6/8) mottles; weak medium angular blocky structure; fractures readily; friable; few soft lime masses; black manganese coats on faces of peds; about 10 percent coarse fragments; strong effervescence; moderately alkaline; gradual smooth boundary.

C2g—60 to 68 inches; grayish brown (2.5Y 5/2) clay loam; many coarse prominent yellowish brown (10YR 5/4) and few fine prominent weak red (10YR 5/4) mottles; friable to firm; few manganese concretions and manganese coats on faces of peds; about 10 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of solum ranges from 18 to 34 inches. Free lime occurs in the lower part of the solum or just below the solum.

The A1 horizon is 7 to 18 inches thick. The B2 horizon is neutral or mildly alkaline. Typically, it is olive brown, dark olive brown, dark grayish brown, or very dark grayish brown. The B3ca horizon ranges from 0 to 15 inches in thickness. It has limy masses or limy concretions. The C horizon commonly is light olive brown, grayish brown, or light brownish gray clay loam or heavy loam.

Arvilla series

The Arvilla series consists of somewhat excessively drained soils that are moderately rapidly permeable in the surface layer and subsoil and rapidly permeable below. These soils formed in a mantle of moderately coarse textured glacial outwash and drift over sandy and gravelly glacial outwash on stream terraces, outwash plains, and knolls and ridgetops on glacial moraines. Slope ranges from 0 to 15 percent.

Arvilla soils are similar to Sverdrup soils and are near Fordville and Sioux soils. Fordville and Arvilla soils are in similar positions on the landscape. Fordville soils are finer textured than Arvilla soils and have a thicker solum. Sioux soils are coarser textured than Arvilla soils and have a thinner solum. They are on the steeper hills and ridges. Sverdrup soils have a sandy IIC horizon that contains little or no gravel.

Typical pedon of Arvilla sandy loam, 2 to 6 percent slopes, about 100 feet north and 750 feet east of the southwest corner of sec. 22, T. 110 N., R. 42 W.

A1—0 to 9 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; about 3 percent coarse fragments; friable; neutral; clear smooth boundary.

B2—9 to 14 inches; very dark grayish brown (10YR 3/2) sandy loam, very dark grayish brown (10YR 3/2) crushed; weak coarse prismatic structure parting to weak medium subangular blocky; friable; about 5 percent coarse fragments; mildly alkaline; clear smooth boundary.

B3—14 to 19 inches; dark brown (7.5YR 3/2) coarse sandy loam; very weak coarse prismatic structure; very friable; about 15 percent coarse fragments; mildly alkaline; clear smooth boundary.

IIC—19 to 60 inches; dark yellowish brown (10YR 4/4) and brown (10YR 4/3) gravelly loamy coarse sand; single grained; loose; about 30 percent coarse fragments; slight effervescence; moderately alkaline.

The solum is 14 to 22 inches thick. The A horizon is 6 to 10 inches thick and is black or very dark gray. The B2 horizon commonly is dark brown, very dark grayish brown, or very dark brown. Free lime has accumulated in the upper part of the IIC horizon as lime has crusted on the bottom of pebbles or has been dispersed throughout the horizon.

Barnes series

The Barnes series consists of well drained, moderately permeable soils. These soils formed in medium textured glacial till on uplands. Slope ranges from 1 to 18 percent.

Barnes soils are near Buse and Svea soils. They are similar to Ves soils. Buse soils have free carbonates in the A horizon, lack a B horizon, and are steeper than Barnes soils. Svea soils typically are downslope from Barnes soils and are moderately well drained. Ves soils have a higher content of shale fragments than Barnes soils and generally have a slightly higher mean annual soil temperature.

Typical pedon of Barnes loam, 1 to 4 percent slopes, 2,600 feet east and 560 feet north of the southwest corner of sec. 3, T. 109 N., R. 43 W.

Ap—0 to 6 inches; black (10YR 2/1) loam; weak fine granular structure; very friable; about 3 percent coarse fragments; abrupt smooth boundary.

AB—6 to 11 inches; dark brown (10YR 3/3) and dark yellowish brown (10YR 3/4) loam, dark brown (10YR 3/3) crushed; moderate fine and medium subangular blocky structure; friable; many very dark brown (10YR 2/2) worm casts; about 3 percent coarse fragments; neutral; clear irregular boundary.

B2—11 to 16 inches; yellowish brown (10YR 5/4) loam, brown (10YR 4/3) crushed; moderate fine and medium subangular blocky structure; friable; many black (10YR 2/1) worm casts; brown (10YR 4/3) coatings on faces of peds; about 5 percent coarse fragments; mildly alkaline; abrupt wavy boundary.

B3ca—16 to 24 inches; light olive brown (2.5Y 5/4) loam; moderate fine and medium prismatic structure parting to moderate fine and medium subangular blocky; friable; few black (10YR 2/1) worm casts; few very dark grayish brown (2.5Y 3/2) coatings on faces of peds; about 8 percent coarse fragments; violent effervescence; moderately alkaline; abrupt wavy boundary.

C1ca—24 to 34 inches; olive brown (2.5Y 4/4) loam; weak coarse prismatic structure parting to moderate medium and fine subangular blocky; friable; common lime threads and masses; few small iron and manganese oxide masses; about 10 percent coarse fragments; violent effervescence; moderately alkaline; abrupt wavy boundary.

C2—34 to 42 inches; light olive brown (2.5Y 5/4) loam, about 10 percent gray (10YR 2/1); moderate fine and medium subangular blocky structure; friable; few lime threads and masses; few iron oxide masses; about 10 percent coarse fragments; violent effervescence; moderately alkaline; clear wavy boundary.

C3—42 to 60 inches; mixed light olive brown (2.5Y 5/4) and gray (10YR 5/1) loam; few medium prominent yellowish brown (10YR 5/8) mottles; weak medium and coarse subangular blocky structure; firm; few soft iron and manganese oxide masses; about 8 percent coarse fragments; strong effervescence; moderately alkaline.

Depth to free lime ranges from 12 to 22 inches. The A horizon ranges from 6 to 13 inches in thickness and from black to very dark gray in color. Texture throughout the profile is dominantly loam but ranges to clay loam. The content of coarse fragments is 1 to 10 percent. The B2 horizon ranges from dark grayish brown and dark brown to dark yellowish brown and yellowish brown.

Chroma in the Ap horizon of the eroded Barnes soils in Lyon County is 2, which is outside the range defined for the Barnes series. This difference, however, does not greatly alter the use or behavior of the soils.

Bearden series

The Bearden series consists of somewhat poorly drained, moderately permeable, calcareous soils. These soils formed in medium textured and moderately fine textured lacustrine sediments mixed with alluvium by the streams crossing the lake plain. Slope ranges from 0 to 2 percent.

The Bearden soils in Lyon County have a thicker mollic epipedon and have less free lime in the upper part of the solum than is defined as the range for the Bearden series. Also, they have buried A and B horizons and are loam and clay loam between depths of 40 and 60 inches. These differences, however, do not alter the use or behavior of the soils.

Bearden soils are similar to Hamerly soils and are near Colvin and Marysland soils. Hamerly soils formed in loamy glacial till on uplands. Colvin and Marysland soils are at slightly lower elevations than Bearden soils and are more poorly drained. In addition, Marysland soils have a coarser textured C horizon.

Typical pedon of Bearden silty clay loam, in an area of Bearden complex, 1,000 feet east and 1,000 feet north of the southwest corner of sec. 8, T. 111 N., R. 41 W.

A1—0 to 14 inches; black (10YR 2/1) silty clay loam; moderate very fine subangular blocky structure; friable; slight effervescence; mildly alkaline; clear smooth boundary.

B21—14 to 25 inches; very dark grayish brown (10YR 3/2) silt loam; weak very fine subangular blocky structure; friable; many very dark gray (10YR 3/1) and dark grayish brown (10YR 4/2) worm casts; few strong brown (7.5YR 5/6) iron oxide stains; strong effervescence; moderately alkaline; gradual smooth boundary.

B22—25 to 37 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) crushed; weak fine and very fine subangular blocky structure; friable; many very dark gray (10YR 3/1) worm casts; few strong brown (7.5YR 5/6) iron oxide stains; common fine discontinuous pores; strong effervescence; moderately alkaline; abrupt smooth boundary.

A1b—37 to 44 inches; black (10YR 2/1) clay loam; strong very fine subangular blocky and angular blocky structure; firm; about 2 percent coarse fragments; slight effervescence; moderately alkaline; clear smooth boundary.

B2b—44 to 52 inches; mixed very dark gray (10YR 3/1) and grayish brown (2.5Y 5/2) clay loam, very dark gray (10YR 3/1) crushed; weak very fine subangular blocky structure; firm; few dark yellowish brown (10YR 4/4) iron oxide stains; about 2 percent coarse fragments; strong effervescence; moderately alkaline; gradual smooth boundary.

C—52 to 60 inches; grayish brown (2.5Y 5/2) loam; common medium distinct gray (5Y 5/1) mottles; friable; few yellowish brown (10YR 5/8) iron oxide stains; strong effervescence; moderately alkaline.

The A horizon is 10 to 18 inches thick and ranges from black to very dark gray. The mollic epipedon ranges from 16 to more than 40 inches in thickness. Typically, the solum is silty clay loam or silt loam, but thin subhorizons of clay loam and loam are in some pedons. The calcium carbonate equivalent ranges from 10 to 20 percent in the solum. Buried A and B horizons occur in most pedons. They are silty clay loam, silty clay, clay loam, loam, or silt loam. The C horizon has a similar range in texture.

Buse series

The Buse series consists of well drained, moderately permeable or moderately slowly permeable, calcareous soils. These soils formed in medium textured glacial till on uplands. Slope ranges from 2 to 40 percent.

Buse soils are similar to Storden soils and are near Barnes and Forman soils. Storden and Buse soils have similar slopes, but Storden soils have a slightly higher mean annual soil temperature. Barnes and Forman soils have a B horizon and have free carbonates at a greater depth than Buse soils. They are on less steep parts of slopes.

Typical pedon of Buse loam, 25 to 40 percent slopes, about 2,000 feet east and 1,100 feet south of the northwest corner of sec. 10, T. 109 N., R. 43 W.

A1—0 to 7 inches; very dark gray (10YR 3/1) loam; weak and moderate very fine subangular blocky structure; friable; about 2 percent coarse fragments; slight effervescence; mildly alkaline; gradual wavy boundary.

AC—7 to 14 inches; mixed very dark gray (10YR 3/1) and brown (10YR 4/3) loam, dark grayish brown (10YR 4/2) crushed; moderate fine and very fine subangular blocky structure; friable; common roots; many worm casts and root channels; about 4 percent coarse fragments; strong effervescence; mildly alkaline; clear irregular boundary.

C1ca—14 to 26 inches; mixed dark yellowish brown (10YR 4/4) and dark grayish brown (10YR 4/2) loam, olive brown (2.5Y 4/4) crushed; weak fine and medium subangular blocky structure; friable; about 5 percent coarse fragments; strong and violent effervescence; moderately alkaline; gradual smooth boundary.

C2—26 to 60 inches; light olive brown (2.5Y 5/4) loam; few fine distinct yellowish brown (10YR 5/6) and grayish brown (2.5Y 5/2) mottles; weak medium subangular blocky structure; firm and friable; few red iron oxide concretions; few soft masses of calcium carbonate; about 8 percent coarse fragments; strong effervescence; moderately alkaline.

The A1 horizon is 6 to 10 inches thick. It is black or very dark gray. Free lime typically is throughout the A and C horizons, but in some pedons the A horizon is partly or completely free of lime. Reaction is mildly alkaline or moderately alkaline. The C horizon is loam or clay loam, and it is typically light olive brown, dark grayish brown, or grayish brown.

Canisteo series

The Canisteo series consists of poorly drained, moderately permeable, calcareous soils. These soils formed in medium textured and moderately fine textured glacial material on the rims of depressions. Slope ranges from 0 to 2 percent.

Canisteo soils are near Glencoe and Seaforth soils and are similar to Vallers soils. Glencoe soils lack free lime in the solum, have a thicker A horizon than Canisteo soils, and are at slightly lower elevations. Seaforth soils are better drained than Canisteo soils and are slightly upslope from those soils. Vallers soils generally contain more lime in the upper part of the solum than Canisteo soils and formed in areas where the mean annual soil temperature is slightly lower.

Typical pedon of Canisteo clay loam, 90 feet south of a field and 420 feet west of the northeast corner of sec. 30, T. 111 N., R. 40 W.

Ap—0 to 9 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; friable; slight effervescence; moderately alkaline; abrupt smooth boundary.

A12—9 to 16 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; friable; slight effervescence; moderately alkaline; clear smooth boundary.

A3g—16 to 22 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) crushed; few medium distinct grayish brown (2.5Y 5/2) mottles; weak very fine subangular blocky structure; friable; about 5 percent coarse fragments; strong effervescence; moderately alkaline; gradual irregular boundary.

B2g—22 to 31 inches; grayish brown (2.5Y 5/2) clay loam; few fine faint light olive brown (2.5Y 5/6) mottles; weak fine subangular blocky structure; friable; about 5 percent coarse fragments; strong effervescence; mildly alkaline; gradual smooth boundary.

C1g—31 to 39 inches; grayish brown (2.5Y 5/2) loam; common medium faint olive yellow (2.5Y 6/6) mottles; weak very fine subangular blocky structure; friable; common gypsum crystals; about 5 percent coarse fragments; strong effervescence; moderately alkaline; gradual smooth boundary.

C2g—39 to 60 inches; light olive gray (5Y 6/2) loam; many coarse prominent yellowish brown (10YR 5/6) mottles; massive; few masses of gypsum crystals; about 5 percent coarse fragments; few manganese oxide stains on fracture faces; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 20 to 36 inches. The soils are calcareous throughout and are mildly alkaline or moderately alkaline. The content of coarse fragments typically is 2 to 8 percent, but in some pedons the upper 20 inches or less has no coarse fragments.

The solum dominantly is clay loam or silty clay loam that is high in content of sand, but in some pedons it has horizons of loam and silt loam. The A horizon is 12 to 20 inches thick and ranges from black to very dark gray when moist and from very dark gray to gray when dry. The B horizon is gray, dark gray, grayish brown, olive gray, or dark grayish brown. The C horizon is loam or light clay loam. It is olive gray, olive, light olive gray, or grayish brown.

Colvin series

The Colvin series consists of poorly drained, moderately slowly permeable and moderately permeable, calcareous soils. These soils formed in medium textured and moderately fine textured lacustrine sediments mixed with alluvium deposited by the streams that cross the lake plain. Slope ranges from 0 to 2 percent.

The Colvin soils in Lyon County have a buried horizon and have less free lime in the upper part of the solum than is defined as the range for the Colvin series. These differences, however, do not alter the use or behavior of the soils.

Colvin soils are near Bearden and Marysland soils. Bearden soils are at slightly higher elevations than Colvin soils and are better drained. Marysland soils have a coarser textured C horizon than Colvin soils.

Typical pedon of Colvin clay loam, in an area of Colvin complex, 45 feet north and 85 feet east of the southwest corner of sec. 36, T. 112 N., R. 42 W.

Ap—0 to 9 inches; black (10YR 2/1) clay loam; weak very fine subangular blocky structure; sticky; slight effervescence; moderately alkaline; abrupt smooth boundary.

A3—9 to 14 inches; very dark gray (10YR 3/1) and black (10YR 2/1) silt loam, very dark gray (10YR 3/1) crushed; moderate very fine subangular blocky structure; friable; strong effervescence; moderately alkaline; clear smooth boundary.

B21g—14 to 25 inches; dark gray (10YR 4/1) loam; common medium faint gray (10YR 5/1 and 6/1) mottles; weak very fine and fine subangular blocky structure; friable; few dark brown (7.5YR 4/4) iron oxide stains; violent effervescence; moderately alkaline; gradual smooth boundary.

B22g—25 to 33 inches; mixed dark gray (5Y 4/1) and very dark gray (5Y 3/1) clay loam, very dark gray (5Y 3/1) crushed; few fine prominent dark yellowish brown (10YR 4/4) mottles; weak fine and medium subangular blocky structure; friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

A1b—33 to 44 inches; black (N 2/0) silty clay loam; moderate fine and very fine angular and subangular blocky structure; firm; few fragments of snail shells; slight effervescence; moderately alkaline; clear irregular boundary.

Cg—44 to 60 inches; mixed gray (5Y 5/1), dark gray (5Y 4/1), and very dark gray (5Y 3/1) silty clay loam; few fine prominent yellowish brown (10YR 5/8) mottles; massive; friable; about 2 percent coarse fragments; few 10- to 25-millimeter hard and soft masses of lime; strong effervescence; moderately alkaline.

The mollic epipedon, or the A horizon, is 14 to 20 inches thick and is black or very dark gray. Typically, the solum is loam and clay loam, but it ranges to silt loam and silty clay loam. It averages less than 15 percent fine sand and coarser sand. Most pedons do not have a horizon in which lime has accumulated at a depth of 16 inches or less. Typically, the content of calcium carbonate ranges from 12 to 20 percent in the solum. Some pedons lack a B horizon. The buried A and B horizons typically are silty clay loam but are silty clay, clay loam, loam, or silt loam in some pedons. The C horizon has a similar range in texture.

Darnen series

The Darnen series consists of moderately well drained, moderately permeable soils. These soils formed in medium textured local colluvial and alluvial sediments on foot slopes in the uplands. Slope ranges from 2 to 6 percent.

Darnen soils are near Buse and Svea soils. They are similar to La Prairie soils. Buse soils are steeper than Darnen soils and are above those soils on the landscape. In addition, Buse soils have a thin calcareous A horizon. Svea soils also have a thinner A horizon than Darnen soils. La Prairie soils are on bottom land. They have a calcareous solum.

Typical pedon of Darnen loam, 2 to 6 percent slopes, 1,100 feet west and 100 feet south of the northeast corner of sec. 7, T. 109 N., R. 42 W.

Ap—0 to 6 inches; black (10YR 2/1) loam; weak very fine and fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

A12—6 to 15 inches; black (10YR 2/1) loam; moderate very fine subangular blocky structure; friable; neutral; gradual smooth boundary.

A13—15 to 27 inches; black (10YR 2/1) loam; weak coarse prismatic structure parting to moderate very fine and fine subangular blocky; friable; neutral; gradual smooth boundary.

B2—27 to 42 inches; mixed very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) loam, very dark grayish brown (10YR 3/2) crushed; moderate medium prismatic structure parting to moderate very fine and fine subangular blocky; friable; many very dark gray (10YR 3/1) worm casts; common pores and root channels; neutral; clear smooth boundary.

B3—42 to 47 inches; mixed very dark grayish brown (2.5Y 3/2) and olive brown (2.5Y 4/4) loam, dark grayish brown (2.5Y 4/2) crushed; weak fine and medium subangular blocky structure; friable; slight effervescence; mildly alkaline; clear smooth boundary.

Cca—47 to 60 inches; olive brown (2.5Y 4/4) loam; few fine distinct yellowish brown (10YR 5/4) mottles; massive; friable; few soft masses and few hard concretions of calcium carbonate, 5 to 25 millimeters in size; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 30 to 50 inches. The A horizon ranges from 24 to 36 inches in thickness. Typically, it is loam or silt loam, but in some pedons it has subhorizons of heavy sandy loam or light clay loam. It typically is black throughout but ranges to very dark gray in the lower part. The B horizon ranges from very dark brown and very dark grayish brown to dark grayish brown and olive brown. The B and C horizons typically are loam, but in some pedons they are silt loam or light clay loam. The depth to free lime ranges from about 3 to 4 feet. The C horizon is mildly alkaline or moderately alkaline.

Everly series

The Everly series consists of well drained, moderately slowly permeable soils. These soils formed in moderately fine textured glacial till on uplands. Slope ranges from 2 to 18 percent.

The Everly soils in Lyon County are outside the range defined for the Everly series because they formed almost entirely in glacial till. This difference, however, does not alter the use or behavior of the soils.

Everly soils are similar to Ves soils and are near Storden, Wilmonton, and Letri soils. Ves soils contain more lime in the lower part of the solum than Everly soils. Wilmonton soils are downslope from Everly soils and are moderately well drained. Letri soils have a thicker A horizon than Everly soils, are wetter, and have a mottled B horizon. They are in drainageways and in other low areas.

Typical pedon of Everly clay loam, 2 to 4 percent slopes, 1,175 feet west and 190 feet south of the northeast corner of sec. 27, T. 109 N., R. 40 W.

Ap—0 to 10 inches; very dark gray (10YR 3/1) clay loam; weak very fine and fine subangular blocky structure; friable; about 3 percent coarse fragments; neutral; abrupt smooth boundary.

B21—10 to 18 inches; brown (10YR 4/3) clay loam; weak fine and very fine subangular blocky structure; firm to friable; many very dark gray (10YR 3/1) worm casts in upper part; about 3 percent coarse fragments; neutral; clear smooth boundary.

B22—18 to 26 inches; dark yellowish brown (10YR 4/4) clay loam; weak fine and very fine subangular blocky structure; firm to friable; about 3 percent coarse fragments; neutral; clear smooth boundary.

C1—26 to 35 inches; yellowish brown (10YR 5/4) loam; common fine prominent gray (5Y 5/1) mottles; very weak very fine subangular blocky structure; friable to firm; few soft accumulations of lime; few reddish stains and accumulations of iron oxides; about 5 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

C2—35 to 60 inches; yellowish brown (10YR 5/4) loam; many medium prominent gray (5Y 5/1) mottles; massive; friable to firm; few fine soft accumulations of lime; few reddish stains and accumulations of iron oxides; about 7 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum typically is 24 to 30 inches but ranges from 20 to 40 inches. It is commonly the same as the depth to carbonates.

The Ap horizon is 8 to 13 inches thick and ranges from black to very dark grayish brown and very dark brown. An A3 or AB horizon is in some pedons. The B horizon commonly ranges from dark brown to dark yellowish brown and yellowish brown. The C horizon commonly is yellowish brown, light olive brown, and grayish brown. Consistence is friable or firm.

Flom series

The Flom series consists of poorly drained, moderately slowly permeable soils. These soils formed in medium textured or moderately fine textured glacial material on uplands. Slope ranges from 0 to 2 percent.

Flom soils are similar to Fulda soils and are near Barnes, Svea, and Vallers soils. Fulda soils are more clayey than Flom soils. Barnes and Svea soils are upslope from Flom soils and are better drained than those soils. Vallers soils are calcareous throughout the solum.

Typical pedon of Flom clay loam, 1,950 feet east and 85 feet north of the southwest corner of sec. 6, T. 112 N., R. 43 W.

Ap—0 to 10 inches; black (10YR 2/1) clay loam; weak very fine subangular blocky structure; firm; organic mottles; neutral; abrupt smooth boundary.

A3—10 to 20 inches; very dark grayish brown (2.5Y 3/2) clay loam; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; firm; about 5 percent coarse fragments; few black tongues; slightly acid; gradual smooth boundary.

B2g—20 to 34 inches; dark gray (5Y 4/1) clay loam; common fine distinct dark yellowish brown (10YR 4/4) mottles; strong fine and very fine angular blocky structure; firm; about 3 percent coarse fragments; few tongues of the A horizon; few manganese oxide concretions; neutral; clear smooth boundary.

B3g—34 to 39 inches; dark gray (5Y 4/1) clay loam; common medium prominent dark yellowish brown (10YR 4/4) mottles; weak very fine and fine subangular and angular blocky structure; firm; about 9 percent coarse fragments; mildly alkaline; clear wavy boundary.

C1g—39 to 60 inches; olive gray (5Y 5/2) clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; friable; about 8 percent coarse fragments; few calcium carbonate and iron oxide concretions; strong effervescence; moderately alkaline.

The depth to free lime ranges from 20 to 40 inches and in most pedons coincides with the thickness of the solum. The Flom soils that formed on the Coteau slope generally are more deeply leached than those that formed on the Altamont Moraine.

The A horizon is 15 to 24 inches thick. It is dominantly clay loam but ranges to silty clay loam that is high in content of sand. Less commonly, it ranges to loam. The B horizon is typically clay loam but ranges to silty clay loam and loam. It is friable or firm. It is commonly olive gray, dark gray, grayish brown, or dark grayish brown. The C horizon is loam or clay loam glacial till.

Fordville series

The Fordville series consists of well drained soils that are moderately permeable in the upper part and rapidly permeable in the lower part. These soils formed in medium textured glacial outwash over sand and gravel. They are on terraces, outwash plains, and gravelly uplands. Slope ranges from 0 to 6 percent.

Fordville soils are near Arvilla and Sverdrup soils. The solum in Arvilla and Sverdrup soils is coarser textured than that in Fordville soils, and the depth to sand and gravel is less.

Typical pedon of Fordville loam, 2 to 6 percent slopes, 1,220 feet east and 30 feet south of the northwest corner of SW1/4 sec. 8, T. 110 N., R. 43 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) crushed; weak very fine subangular blocky structure; hard, friable; few spots of dark brown (10YR 3/3); neutral; abrupt smooth boundary.

B2—10 to 21 inches; dark brown (10YR 3/3) loam, brown (10YR 4/3) in the lower part; weak coarse prismatic structure parting to weak medium subangular blocky; hard, friable; neutral; clear wavy boundary.

B3ca—21 to 26 inches; mixed dark yellowish brown (10YR 4/4) and pale brown (10YR 6/3) loam, yellowish brown (10YR 5/4) crushed; very weak medium subangular blocky structure; hard, friable; about 10 percent gravel; violent effervescence; mildly alkaline; abrupt wavy boundary.

IIC—26 to 60 inches; dark yellowish brown (10YR 4/4) gravelly coarse sand; single grained; loose; about 35 percent gravel; slight effervescence; moderately alkaline.

The depth to sand and gravel is the same as the thickness of the solum. Typically, it is 24 to 30 inches, but it ranges from 20 to 40 inches.

The A horizon is 6 to 12 inches thick and ranges from black to very dark gray and to very dark brown in the lower part. The B horizon is mostly dark yellowish brown, brown, dark brown, or dark grayish brown. Free lime is in the IIC horizon and in the lower part of the B horizon in some pedons. The IIC horizon ranges from gravelly coarse sand to stratified sand and gravel.

Forman series

The Forman series consists of well drained soils that are moderately slowly permeable. These soils formed in moderately fine textured glacial till on uplands. Slope ranges from 2 to 18 percent.

Most of the Forman soils in Lyon County do not have an argillic horizon because the necessary increase in content of clay is not evident. As a result, these soils are outside the range defined for the Forman series. This difference, however, does not alter the use and behavior of the soils.

Forman soils are near Aastad soils and are similar to Barnes soils. Aastad soils have a thicker A horizon and a more olive colored B horizon than Forman soils. They are slightly downslope from those soils and are moderately well drained. Barnes soils are more friable than Forman soils and contain less clay.

Typical pedon of Forman clay loam, 2 to 4 percent slopes, 1,845 feet east and 190 feet north of the southwest corner of sec. 6, T. 112 N., R. 43 W.

Ap—0 to 7 inches; black (10YR 2/1) and very dark gray (10YR 3/1) clay loam; weak very fine and fine angular blocky structure; hard; about 2 percent coarse fragments; neutral; abrupt smooth boundary.

A3—7 to 11 inches; mixed very dark gray (10YR 3/1) and dark brown (10YR 3/3) clay loam, very dark grayish brown (10YR 3/2) crushed; weak medium prismatic structure parting to moderate very fine subangular blocky; hard, firm; about 3 percent coarse fragments; neutral; clear irregular boundary.

B2—11 to 19 inches; dark brown (10YR 4/3) clay loam; moderate medium prismatic structure parting to weak fine subangular blocky; firm; few thin clay films on vertical faces of peds; about 3 percent coarse fragments; neutral; clear smooth boundary.

B3ca—19 to 25 inches; light olive brown (2.5Y 5/4) clay loam; weak medium prismatic structure parting to weak very fine subangular blocky; friable; about 10 percent coarse fragments; few iron oxide concretions; strong effervescence; mildly alkaline; gradual smooth boundary.

C1ca—25 to 33 inches; grayish brown (2.5Y 5/2) clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak and moderate very fine and fine subangular blocky structure; friable; about 8 percent coarse fragments; few soft white masses of lime; strong and violent effervescence; moderately alkaline; gradual smooth boundary.

C2—33 to 60 inches; grayish brown (2.5Y 5/2) clay loam; common coarse faint olive brown (2.5Y 4/4) mottles; friable; about 8 percent coarse fragments; common iron oxide concretions; strong and violent effervescence; moderately alkaline.

Depth to free lime ranges from 15 to 26 inches. The content of pebbles, cobbles, and boulders is 2 to 10 percent.

The A1 horizon is 6 to 14 inches thick. It is dominantly black but ranges to very dark gray and is typically clay loam but ranges to heavy loam. The B2 horizon is brown, dark brown, or dark grayish brown. It is 30 to 35 percent clay. The B3ca horizon is light olive brown, grayish brown, or yellowish brown. The C horizon is firm or friable clay loam or loam glacial till. It has colors similar to those of the B3ca horizon.

Fulda series

The Fulda series consists of poorly drained, slowly permeable soils. These soils formed in fine textured and moderately fine textured glacial lacustrine sediments on ice-walled lake plains in the uplands. Slope ranges from 0 to 2 percent.

Fulda soils are near Sinai soils and are similar to Flom soils. Sinai soils are at slightly higher elevations than Fulda soils and are better drained. Flom soils contain less clay than Fulda soils.

Typical pedon of Fulda silty clay, 50 feet west and 300 feet south of the northeast corner of SE1/4 sec. 7, T. 110 N., R. 43 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; hard, firm; neutral; abrupt smooth boundary.

A12—8 to 17 inches; black (N 2/0) silty clay; moderate and strong very fine subangular blocky structure; hard, firm; neutral; gradual smooth boundary.

B21g—17 to 22 inches; very dark gray (10YR 3/1) grading to very dark grayish brown (2.5Y 3/2) silty clay; few fine distinct yellowish brown (10YR 5/8) mottles; moderate very fine angular and subangular blocky structure; firm; mildly alkaline; clear smooth boundary.

B22g—22 to 28 inches; grayish brown (2.5Y 5/2) silty clay; few medium distinct yellowish brown (10YR 5/6) mottles; weak and moderate very fine subangular blocky structure; firm; few very dark gray (10YR 3/1) tongues; slight effervescence; moderately alkaline; gradual smooth boundary.

C1g—28 to 60 inches; gray (5Y 6/1) silty clay; common medium and coarse prominent yellowish brown (10YR 5/6) mottles; massive; firm; few soft white masses, 1 millimeter to 5 millimeters in size, of calcium carbonate in the upper part; strong and violent effervescence; moderately alkaline.

The depth to free lime typically ranges from 20 to 30 inches. The thickness of the solum ranges from 24 to 42 inches. The solum ranges from 35 to 50 percent clay. It is silty clay loam or silty clay.

The A horizon is 14 to 20 inches thick. The B2g horizon ranges from very dark gray and very dark grayish brown to dark gray, olive gray, and grayish brown. The texture of the Cg horizon is similar to that of the solum. In some pedons this horizon has thin layers that are coarser textured. Accumulations of lime are common in the lower part of the B horizon or the upper part of the Cg horizon, or both.

Glencoe series

The Glencoe series consists of very poorly drained, moderately slowly permeable soils. These soils formed in moderately fine textured glacial material in shallow, closed depressions. Slope is 0 to 1 percent.

Glencoe soils are near Canisteo soils. They are similar to Quam soils. Canisteo soils are calcareous, have a thinner mollic epipedon than Glencoe soils, and are at a slightly higher elevation. Quam soils generally are more silty than Glencoe soils and have a slightly lower mean annual soil temperature.

Typical pedon of Glencoe silty clay loam, 2,500 feet east and 150 feet north of the southwest corner of sec. 15, T. 111 N., R. 40 W.

Ap—0 to 10 inches; black (N 2/0) silty clay loam; weak very fine subangular blocky structure; firm; abrupt smooth boundary.

A12—10 to 17 inches; black (N 2/0) clay loam; weak and moderate fine subangular blocky structure; firm; neutral; gradual smooth boundary.

A13—17 to 30 inches; black (N 2/0 and 5Y 2/1) clay loam; weak and moderate very fine and fine subangular blocky structure; firm; neutral; gradual smooth boundary.

A3g—30 to 42 inches; black (5Y 2/1) clay loam; weak and moderate very fine and fine angular blocky and subangular blocky structure; firm; few thin patchy clay films on faces of peds; neutral; clear irregular boundary.

B2g—42 to 47 inches; olive gray (5Y 5/2) clay loam, dark gray (5Y 4/1) crushed; common medium distinct light olive brown (2.5Y 5/4) and few fine faint olive (5Y 4/3) mottles; weak fine and medium subangular blocky structure; very firm; common black (5Y 2/1) tongues; about 3 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C1g—47 to 60 inches; olive gray (5Y 5/2) clay loam; common medium prominent yellowish brown (10YR 5/8) and common medium faint olive (5Y 4/3) mottles; massive; friable; about 3 percent coarse fragments; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free lime commonly are 36 to 54 inches. Coarse fragments make up 0 to 5 percent of the solum and 2 to 8 percent of the C horizon. The solum is commonly clay loam or silty clay loam but ranges to heavy loam.

The A horizon ranges from 24 to 42 inches in thickness. The B horizon is dark gray, dark olive gray, or olive gray. The C horizon is loam or light clay loam and commonly is olive gray, light olive gray, or olive.

Hamerly series

The Hamerly series consists of somewhat poorly drained and moderately well drained, moderately slowly permeable, calcareous soils. These soils formed in medium textured glacial till on glaciated uplands. Slope ranges from 1 to 3 percent.

The Hamerly soils in Lyon County have less lime in the "ca" horizon than is defined as the range for the Hamerly series. This difference, however, does not alter the use or behavior of the soils.

Hamerly soils are similar to Seaforth soils and are near Vallers and Svea soils. Seaforth and Hamerly soils have similar slopes, but Seaforth soils have a slightly higher mean annual soil temperature. Vallers soils are downslope from Hamerly soils and are poorly drained. Svea soils lack free carbonates in the solum and have more distinct horizons than Hamerly soils. Hamerly and Svea soils are in similar positions on the landscape, but Svea soils are in areas that are more concave.

Typical pedon of Hamerly loam, 1 to 3 percent slopes, 1,200 feet north and 530 feet west of the southeast corner of sec. 28, T. 109 N., R. 41 W.

A1—0 to 10 inches; black (10YR 2/1) loam; moderate very fine and fine subangular blocky structure; friable; about 3 percent coarse fragments; slight effervescence; mildly alkaline; clear smooth boundary.

A3—10 to 17 inches; mixed very dark gray (10YR 3/1) and dark grayish brown (2.5Y 4/2) loam, dark gray (10YR 4/1) crushed; moderate very fine subangular blocky structure; friable; about 3 percent coarse fragments; strong effervescence; mildly alkaline; clear irregular boundary.

B2ca—17 to 26 inches; dark grayish brown (2.5Y 4/2) loam; common fine faint olive brown (2.5Y 4/4) mottles; weak medium subangular blocky structure; friable; about 3 percent coarse fragments; few fine gypsum crystals; few very dark gray (10YR 3/1) worm casts; strong effervescence; moderately alkaline; gradual irregular boundary.

C1ca—26 to 40 inches; light olive brown (2.5Y 5/4) loam; common medium faint grayish brown (2.5Y 5/2) mottles; weak medium subangular blocky structure; friable; about 5 percent coarse fragments; few lime accumulations; few iron oxide accumulations; strong effervescence; moderately alkaline; gradual smooth boundary.

C2g—40 to 60 inches; gray (5Y 5/1) loam; common medium distinct olive brown (2.5Y 4/4) mottles; massive; friable; about 5 percent coarse fragments; few masses of gypsum crystals; slight effervescence; moderately alkaline.

Typically, the solum is loam, but some pedons have subhorizons that range to light clay loam, silt loam, or sandy clay loam. The A1 horizon is black or very dark gray and is 6 to 12 inches thick. The B2 horizon is light brownish gray, dark grayish brown, or olive brown. It has strong or violent effervescence. The C horizon has few to many, faint to prominent, fine or medium mottles.

Lamoure series

The Lamoure series consists of poorly drained, moderately permeable soils. These soils formed in moderately fine textured sediments that were deposited by floodwater on flood plains. Slope ranges from 0 to 2 percent.

Lamoure soils are similar to Colvin soils and are near La Prairie and Rauville soils. Colvin soils have a thinner mollic epipedon than Lamoure soils. La Prairie soils are more loamy than Lamoure soils. They are at a slightly higher elevation and are better drained. Rauville soils are at a slightly lower elevation than Lamoure soils and have a shallower seasonal high water table.

Typical pedon of Lamoure silty clay loam, 1,300 feet north and 50 feet east of the southwest corner of sec. 6, T. 113 N., R. 42 W.

Ap—0 to 10 inches; black (10YR 2/1) silty clay loam; cloddy; firm; slight effervescence; mildly alkaline; abrupt smooth boundary.

A12—10 to 17 inches; black (N 2/0) silty clay loam; moderate very fine subangular blocky structure; friable; slight effervescence; mildly alkaline; gradual smooth boundary.

A13—17 to 25 inches; very dark gray (N 3/0) silty clay loam; weak and moderate very fine subangular blocky structure; friable; slight effervescence; mildly alkaline; clear smooth boundary.

B2g—25 to 38 inches; very dark gray (10YR 3/1) silty clay loam; few fine distinct grayish brown (2.5Y 5/2) mottles; weak very fine and fine subangular blocky structure; friable; strong effervescence; moderately alkaline; clear smooth boundary.

C1gca—38 to 43 inches; mixed grayish brown (2.5Y 5/2), very dark grayish brown (2.5Y 3/2), and light yellowish brown (2.5Y 6/4) silty clay loam, dark grayish brown (2.5Y 4/2) crushed; weak very fine subangular blocky structure; friable; few soft lime masses; violent effervescence; moderately alkaline; clear smooth boundary.

C2g—43 to 60 inches; dark grayish brown (2.5Y 4/2) silty clay loam; structureless and weak fine and medium subangular blocky structure; friable; many fine iron and manganese oxide stains and concretions; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 38 inches. The soils are mildly alkaline or moderately alkaline throughout. Between depths of 10 and 40 inches, they typically are silty clay loam that is less than 35 percent clay, but horizons containing more clay and horizons of silt loam are in some pedons.

The A1 horizon is 15 to 20 inches thick. The B2 horizon is black or very dark gray. The Cg horizon typically is grayish brown, dark grayish brown, dark olive gray, or olive gray. Typically, it has a texture similar to that of the solum, but it also has sandy or clayey strata in some pedons.

La Prairie series

The La Prairie series consists of moderately well drained, moderately permeable soils. These soils formed in medium textured stream-deposited sediments on bottom land. Slope ranges from 0 to 2 percent.

La Prairie soils are near Lamoure soils. They are similar to the Darnen soils on uplands. Lamoure soils are at a slightly lower elevation than La Prairie soils and have a shallower seasonal high water table. Darnen soils have a neutral solum, formed in local colluvium, and are not subject to flooding.

Typical pedon of La Prairie loam, 1,560 feet east and 35 feet south of the southwest corner of sec. 14, T. 110 N., R. 40 W.

Ap—0 to 7 inches; black (10YR 2/1) loam; weak very fine subangular blocky structure; friable; mildly alkaline; abrupt smooth boundary.

A12—7 to 17 inches; black (10YR 2/1) loam; weak very fine and fine subangular blocky structure; friable; mildly alkaline; clear smooth boundary.

A3—17 to 30 inches; very dark gray (10YR 3/1) loam; weak very fine subangular blocky structure; friable; strong effervescence; mildly alkaline; gradual smooth boundary.

B2—30 to 40 inches; mixed dark grayish brown (10YR 4/2) and very dark gray (10YR 3/1) loam, very dark grayish brown (10YR 3/2) crushed; very weak fine subangular blocky structure; friable; strong effervescence; mildly alkaline; gradual smooth boundary.

C—40 to 60 inches; very dark grayish brown (2.5Y 3/2) stratified silt loam and fine sand; common fine distinct dark yellowish brown (10YR 4/4) mottles; massive and single grained; friable, loose; strong effervescence; mildly alkaline.

The solum typically is 30 to 50 inches thick, but in some pedons it is more than 60 inches thick. It is dominantly loam or silt loam, but in some pedons it is light silty clay loam that is high in content of sand. Depth to free lime typically ranges from 10 to 24 inches, but some pedons have free lime throughout.

The A1 horizon is 16 to 36 inches thick. The B2 horizon ranges from very dark gray to dark grayish brown. The C horizon typically has a texture similar to that of the solum, but in many pedons it has thin strata that are sandy or clayey. A buried A horizon is at a depth of more than 40 inches in some pedons. It is black or very dark gray.

Letri series

The Letri series consists of poorly drained, moderately slowly permeable soils. These soils formed in medium textured and moderately fine textured glacial sediments on uplands. Slope ranges from 0 to 2 percent.

Letri soils are similar to Flom soils and are near Glencoe and Wilmonton soils. Flom soils have a slightly lower mean annual soil temperature than Letri soils. Glencoe soils have a thicker mollic epipedon than Letri soils. They are in shallow depressions. Wilmonton soils are upslope from Letri soils and are moderately well drained.

Typical pedon of Letri clay loam, 1,056 feet north and 924 feet west of the southeast corner of sec. 6, T. 109 N., R. 40 W.

Ap—0 to 8 inches; black (N 2/0) clay loam; weak very fine subangular blocky structure; firm; about 2 percent coarse fragments; neutral; abrupt smooth boundary.

A12—8 to 15 inches; black (N 2/0) clay loam; moderate very fine and fine subangular blocky structure; friable; about 2 percent coarse fragments; neutral; gradual wavy boundary.

A3—15 to 20 inches; very dark gray (N 3/0) clay loam; weak very fine subangular blocky structure; firm; about 2 percent coarse fragments; neutral; gradual wavy boundary.

B2g—20 to 30 inches; dark gray (5Y 4/1) clay loam; few fine prominent yellowish brown (10YR 5/6) mottles; moderate fine prismatic structure parting to moderate fine subangular blocky and angular blocky; firm; about 3 percent coarse fragments; few thin patchy clay films on vertical faces of prisms; neutral; clear smooth boundary.

B3g—30 to 35 inches; olive gray (5Y 5/2) clay loam; common medium prominent yellowish brown (10YR 5/4) mottles; weak fine subangular blocky structure; friable to firm; about 4 percent coarse fragments; mildly alkaline; clear smooth boundary.

Cg—35 to 60 inches; olive gray (5Y 5/2) loam; common medium distinct light olive brown (2.5Y 5/4) mottles; massive; friable to firm; about 8 percent coarse fragments; few accumulations of iron and manganese oxides; slight effervescence, strong effervescence in spots; moderately alkaline.

The thickness of the solum generally ranges from 20 to 36 inches. Typically it is the same as the depth to free lime, but in some pedons the B horizon contains free carbonates.

The A horizon is clay loam or light to medium silty clay loam that has a moderate sand content. It is 14 to 20 inches thick. The B horizon has a similar range in texture. It is typically dark gray, olive gray, and grayish brown. The C horizon has colors similar to those of the B horizon. It is commonly heavy loam, but in some pedons it is light clay loam.

Malachy series

The Malachy series consists of moderately well drained and somewhat poorly drained, calcareous soils that are

moderately rapidly permeable. These soils formed in medium textured glacial lacustrine sediments over sandy sediments. They are on slight elevations on the lake plain that formerly were streambeds, beaches, and sandbars. Slope ranges from 0 to 2 percent.

The Malachy soils in Lyon County have a mollic epipedon that is thinner than is defined as the range for the series. This difference, however, does not alter the use or behavior of the soils.

Malachy soils are similar to Bearden, Colvin, and Marysland soils. Bearden soils are finer textured than Malachy soils. They are at the same elevation on the lake plain. Colvin and Marysland soils are at a slightly lower elevation than Malachy soils. They have a shallower seasonal high water table. In addition, Colvin soils have a finer textured solum and C horizon.

Typical pedon of Malachy loam, 1,320 feet north and 85 feet west of the southeast corner of sec. 1, T. 111 N., R. 42 W.

Ap—0 to 8 inches; black (10YR 2/1) loam; weak very fine subangular blocky structure; friable; mildly alkaline; clear smooth boundary.

A12—8 to 11 inches; black (10YR 2/1) loam; weak very fine and fine subangular blocky structure; friable; slight effervescence; mildly alkaline; clear smooth boundary.

A3—11 to 15 inches; mixed very dark gray (10YR 3/1) and dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) crushed; weak fine subangular blocky structure; friable; slight effervescence; mildly alkaline; clear irregular boundary.

B2ca—15 to 25 inches; dark grayish brown (2.5Y 4/2) loam; few fine faint olive brown (2.5Y 4/4) mottles; weak medium subangular blocky structure; friable; violent effervescence; mildly alkaline; clear wavy boundary.

B3g—25 to 36 inches; dark grayish brown (2.5Y 4/2) fine sandy loam; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine and medium subangular blocky structure; friable; strong effervescence; mildly alkaline; clear smooth boundary.

IIC—36 to 60 inches; mixed pale brown (10YR 6/3) and light yellowish brown (10YR 6/4) sand; single grained; loose; about 10 percent gravel; slight effervescence; mildly alkaline.

The mollic epipedon, or the A horizon, is less than 16 inches thick and ranges from black to very dark gray and dark grayish brown. The solum is dominantly loam, but it can also be fine sandy loam and silt loam high in content of fine sand. Most pedons have a weakly expressed B2 horizon. The solum ranges in thickness from 20 to 40 inches, which commonly is the same as the depth to the sandy IIC horizon. It is mildly alkaline or moderately alkaline. The calcium carbonate equivalent in the solum is less than 15 percent. The IIC horizon ranges from loamy sand to coarse sand.

Marysland series

The Marysland series consists of poorly drained, moderately permeable, calcareous soils. These soils formed in medium textured lacustrine sediments overlying sandy material. They are in low areas on the lake plain, on stream deltas, and in overflow channels between some of the streams that cross the lowland plain. Slope ranges from 0 to 2 percent.

The Marysland soils in this county have a IIC horizon that contains more silt and clay and less sand than is defined as the range for the Marysland series. This difference, however, does not alter the use or behavior of the soils.

Marysland soils are near the Colvin and Malachy soils. Colvin soils have a finer textured IIC horizon than Marysland soils. Malachy soils are at a slightly higher elevation than Marysland soils and are better drained.

Typical pedon of Marysland loam, 300 feet east and 90 feet south of the northwest corner of sec. 28, T. 112 N., R. 40 W.

Ap—0 to 6 inches; black (10YR 2/1) loam; weak very fine subangular blocky structure; friable, slightly sticky; strong effervescence; mildly alkaline; abrupt smooth boundary.

A12—6 to 13 inches; black (10YR 2/1) loam; weak very fine subangular blocky structure; friable; strong effervescence; mildly alkaline; clear smooth boundary.

A3ca—13 to 18 inches; mixed very dark gray (N 3/0), black (10YR 2/1), and dark gray (5Y 4/1) loam, very dark gray (5Y 3/1) crushed; weak very fine and fine subangular blocky structure; friable; few threads of segregated lime; violent effervescence; moderately alkaline; clear irregular boundary.

B2gca—18 to 29 inches; mixed dark gray (5Y 4/1), gray (5Y 5/1), and very dark gray (10YR 3/1) loam; common medium distinct light olive brown (2.5Y 5/4) mottles in the lower part; weak fine and medium subangular blocky structure; friable; common threads of segregated lime; violent effervescence; moderately alkaline; clear smooth boundary.

IIC1g—29 to 42 inches; dark grayish brown (2.5Y 4/2) fine sandy loam; common medium faint light olive brown (2.5Y 5/4) mottles; weak medium subangular blocky structure; very friable; strong effervescence; mildly alkaline; gradual smooth boundary.

IIC2g—42 to 60 inches; gray (5Y 5/1) loamy fine sand; many coarse prominent yellowish brown (10YR 5/6) and dark brown (7.5YR 3/2) mottles; single grained; loose; slight effervescence; mildly alkaline.

The mollic epipedon is 12 to 24 inches thick. The A horizon is black and very dark gray. Typically, the solum is loam, but it ranges to light clay loam, sandy clay loam, and heavy sandy loam. Depth to the IIC horizon ranges from 20 to 40 inches. The calcium carbonate equivalent of the calcic horizons ranges from 15 to 25 percent. The soils are mildly alkaline or moderately alkaline throughout. The IIC horizon typically is fine sandy loam and loamy fine sand, but it can also be fine sand, sand, or stratified sand and gravel.

Normania series

The Normania series consists of moderately well drained, moderately permeable soils. These soils formed in medium textured glacial till on the lowland plain. Slope ranges from 1 to 3 percent.

Normania soils are near Canisteo and Ves soils. Canisteo soils are slightly downslope from Normania soils, have a calcareous solum, and are poorly drained. Ves soils are upslope from Normania soils, have a thinner A horizon, and are well drained.

Typical pedon of Normania loam, 1 to 3 percent slopes, 180 feet north and 125 feet east of the southwest corner of sec. 11, T. 112 N., R. 42 W.

Ap—0 to 6 inches; black (10YR 2/1) loam; weak very fine subangular blocky structure; friable; about 2 percent coarse fragments; neutral; abrupt smooth boundary.

A12—6 to 13 inches; black (10YR 2/1) loam; weak very fine subangular blocky structure; friable; about 2 percent coarse fragments; neutral; clear irregular boundary.

A3—13 to 17 inches; very dark gray (10YR 3/1) loam, very dark grayish brown (2.5Y 3/2) crushed; weak very fine and fine subangular blocky structure; friable; many dark grayish brown (2.5Y 4/2) worm casts; about 2 percent coarse fragments; neutral; clear irregular boundary.

B2—17 to 26 inches; dark grayish brown (2.5Y 4/2) loam; weak coarse prismatic structure parting to weak medium subangular blocky; friable; about 3 percent coarse fragments; neutral; clear irregular boundary.

B3ca—26 to 36 inches; olive brown (2.5Y 4/4) loam; common medium distinct grayish brown (2.5Y 5/2) mottles; weak medium subangular blocky structure; friable; about 5 percent coarse fragments; few soft masses of calcium carbonate; strong effervescence; moderately alkaline; gradual smooth boundary.

C1gca—36 to 50 inches; grayish brown (2.5Y 5/2) loam; common medium distinct light olive brown (2.5Y 5/4) mottles; massive; friable; about 5 percent coarse fragments; few soft masses of calcium carbonate; strong effervescence; moderately alkaline; gradual smooth boundary.

C2g—50 to 60 inches; gray (5Y 5/1) loam; common medium distinct light olive brown (2.5Y 5/6) mottles; massive; friable; about 5 percent coarse fragments; few iron oxide stains; slight effervescence; moderately alkaline.

The depth to free lime typically is 24 to 30 inches. The solum and C horizon typically are loam, but some pedons have subhorizons of light clay loam, silt loam, sandy clay loam, or heavy sandy loam. Shale fragments are common to abundant; 20 to more than 50 percent of the coarse fragments that are 2 to 5 millimeters in size are shale fragments.

The A1 horizon is 10 to 15 inches thick and the A3 horizon 3 to 7 inches thick. The B2 horizon commonly is dark grayish brown or olive brown. The C horizon commonly is olive gray, grayish brown, or gray.

Oldham series

The Oldham series consists of poorly drained and very poorly drained, moderately slowly permeable and slowly permeable, calcareous soils. These soils formed in moderately fine textured and fine textured lake-laid sediments in the drained basins of shallow lakes and ponds and in fine textured lacustrine sediments on the lake plain. Slope is 0 to 1 percent.

Oldham soils are similar to Fulda soils and are near the Colvin soils on the lake plain and the Canisteo and Vallers soils on uplands. Fulda soils do not have lime in the solum and have a thinner mollic pipedon than Oldham soils. Colvin, Canisteo, and Vallers soils also have a thinner mollic epipedon and are less clayey. In addition, Canisteo and Vallers soils formed in glacial till.

Typical pedon of Oldham silty clay loam, 1,850 feet west and 115 feet south of the northeast corner of sec. 30, T. 112 N., R. 43 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam; weak fine subangular blocky structure; hard, sticky; few fragments of snail shells; strong effervescence; mildly alkaline; abrupt smooth boundary.

A12—8 to 13 inches; black (10YR 2/1) silty clay loam; moderate very fine subangular blocky structure; firm; few fragments of snail shells; strong effervescence; mildly alkaline; abrupt smooth boundary.

B21gcs—13 to 23 inches; very dark gray (N 3/0) silty clay loam; weak very fine subangular blocky structure; friable; many fine light brownish gray (2.5Y 6/2) gypsum crystals; few fragments of snail shells; slight effervescence; mildly alkaline; clear smooth boundary.

B22g—23 to 31 inches; very dark gray (N 3/0) silty clay loam; few medium faint dark olive gray (5Y 3/2) mottles; weak fine subangular blocky structure; friable; few fine gypsum crystals; some vertical cleavage faces; few fragments of snail shells; strong effervescence; mildly alkaline; gradual smooth boundary.

C1g—31 to 46 inches; dark gray (N 4/0) silty clay loam; few medium faint dark olive gray (5Y 3/2) mottles; massive; friable; few fragments of snail shells; slight effervescence; mildly alkaline; gradual smooth boundary.

C2g—46 to 60 inches; gray (5Y 5/1) silty clay loam; many coarse distinct olive brown (2.5Y 4/4) and common medum distinct very dark gray (N 3/0) mottles; massive; friable; few fragments of snail shells; slight effervescence; mildly alkaline.

These soils typically have free lime throughout, but in some pedons the A horizon has been leached to a depth of 10 inches. The A horizon ranges from black to very dark gray and from silty clay loam to silty clay. The black and very dark gray colors also dominate the B horizon and extend to a depth of 24 to 36 inches. Most pedons have few to many gypsum crystals and segregations of lime. Reaction is mildly alkaline or moderately alkaline. The C1 horizon is silty clay loam or silty clay. A IIC horizon of calcareous loam or clay loam glacial till is at a depth of more than 40 inches in some pedons.

Poinsett series

The Poinsett series consists of well drained, moderately permeable soils. These soils formed in moderately fine textured glacial lacustrine sediments on ice-walled lake plains in the uplands.

Poinsett soils are near the Sinai soils. Sinai soils are more clayey and have a mollic epipedon that is more than 16 inches thick.

Typical pedon of Poinsett silty clay loam, 1 to 4 percent slopes, 1,500 feet north and 35 feet east of the southwest corner of sec. 6, T. 110 N., R. 43 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam; weak very fine subangular blocky structure; slightly hard, friable; neutral; abrupt smooth boundary.

A12—7 to 11 inches; black (10YR 2/1) silty clay loam; moderate very fine subangular blocky structure; friable; neutral; gradual smooth boundary.

B1—11 to 15 inches; mixed very dark brown (10YR 2/2) and dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) crushed; weak and moderate medium prismatic structure parting to moderate very fine and fine subangular blocky; friable; neutral; gradual irregular boundary.

B21—15 to 22 inches; dark yellowish brown (10YR 4/4) silty clay loam, dark brown (10YR 4/3) crushed; weak fine and medium prismatic structure parting to weak and moderate fine subangular blocky; friable; neutral; gradual smooth boundary.

B22—22 to 30 inches; olive brown (2.5Y 4/4) silty clay loam; moderate medium and coarse prismatic structure parting to weak fine subangular blocky; friable; few patchy clay films on vertical faces of peds; neutral; clear irregular boundary.

B3ca—30 to 42 inches; light olive brown (2.5Y 5/4) silt loam; few fine distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to very weak medium subangular blocky; friable; about 3 percent coarse fragments; few 1- to 5-millimeter white soft masses of calcium carbonate; few hard 5- to 15-millimeter calcium carbonate concretions; violent effervescence; moderately alkaline; gradual smooth boundary.

Cg—42 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; friable; about 7 percent coarse fragments; few irregularly shaped calcium carbonate concretions; few white 1- to 5-millimeter soft masses of calcium carbonate; strong and violent effervescence; moderately alkaline.

The depth to free lime ranges from 14 to 34 inches. The A and B horizons typically are silty clay loam, but many pedons have subhorizons of silt loam and a few have subhorizons ranging from loam to light silty clay. The A horizon ranges from 8 to 16 inches in thickness and from black to very dark gray in color. The B2 horizon commonly is dark yellowish brown or olive brown. Some pedons do not have a B3ca horizon. Soft accumulations and hard concretions of free lime are few to many in the B3ca horizon and in the upper part of the C horizon. The C horizon

has textures similar to those of the solum. Some pedons have a IIC horizon of loam glacial till below a depth of 40 inches.

Poinsett silty clay loam, 6 to 12 percent slopes, eroded, lacks a mollic epipedon and is shallower to free carbonates than is defined as the range for the Poinsett series. These differences, however, do not alter the use or behavior of the soil.

Quam series

The Quam series consists of very poorly drained soils that are moderately slowly permeable. These soils formed in moderately fine textured glacial material in closed depressions in the uplands. Slope is 0 to 1 percent.

Quam soils are near Flom and Vallers soils. They are similar to Oldham silty clay loam and to Glencoe soils. Flom and Vallers soils are at a slightly higher elevation than Quam soils and have a thinner mollic epipedon. In addition, Vallers soils are strongly calcareous. The Oldham soil is calcareous. Glencoe soils are fine loamy. Typically, they are at the lower elevations in the county and consequently have slightly higher soil temperatures.

Typical pedon of Quam silty clay loam, 650 feet south and 220 feet west of the northeast corner of sec. 29, T. 109 N., R. 43 W.

Ap—0 to 9 inches; black (N 2/0) silty clay loam; weak and moderate very fine subangular blocky structure; friable, sticky; neutral; abrupt smooth boundary.

A12—9 to 17 inches; black (N 2/0) mucky silt loam; weak fine and very fine subangular blocky structure; friable; neutral; gradual smooth boundary.

A13—17 to 26 inches; black (N 2/0) silty clay loam; moderate very fine subangular blocky structure; firm; neutral; gradual smooth boundary.

A3g—26 to 33 inches; black (10YR 2/1) silty clay loam; weak very fine subangular blocky structure; firm; neutral; few fine red iron oxide accumulations in old root channels; neutral; clear smooth boundary.

B2g—33 to 43 inches; very dark gray (N 3/0) silty clay loam; few fine distinct dark gray (5Y 4/1) mottles; weak fine and medium subangular blocky structure; friable; strong vertical cleavage; few fine red iron oxide accumulations in old root channels; mildly alkaline; clear smooth boundary.

C1g—43 to 50 inches; olive gray (5Y 4/2) silty clay loam; common medium faint very dark gray (5Y 3/1) mottles; massive; friable; few fine red iron oxide accumulations; few fine discontinuous pores; mildly alkaline; gradual smooth boundary.

C2g—50 to 60 inches; olive gray (5Y 5/2) silty clay loam; common medium distinct light olive brown (2.5Y 5/6) and common medium faint dark gray (5Y 4/1) mottles; massive; friable; few very fine discontinuous pores; mildly alkaline.

The A horizon is black and very dark gray and is 24 to 50 inches thick. It typically is silty clay loam, but some pedons have subhorizons of silt loam, loam, or clay loam. The depth to free carbonates typically is 40 to 70 inches. The A horizon typically has no coarse fragments. The B and C horizons are, by volume, 0 to 8 percent coarse fragments. The B2 horizon, if it occurs, is very dark gray or dark gray and is as much as 24 inches thick. The C horizon is silt loam or silty clay loam. A IIC horizon of loam or clay loam glacial till is in some pedons.

Rauville series

The Rauville series consists of very poorly drained, moderately permeable and moderately slowly permeable soils. These soils formed in moderately fine textured alluvium in old stream channels and drainageways that dissect the uplands. Slopes are 0 to 1 percent.

Rauville soils are similar to Oldham soils and are near Lamoure soils. Oldham soils typically are in the drained basins of shallow lakes and ponds. They are more clayey than Rauville soils and generally show evidence of more profile development. Lamoure soils are at a slightly higher elevation on bottom land than Rauville soils and are slightly better drained.

Typical pedon of Rauville silty clay loam, 1,320 feet west and 15 feet north of the southeast corner of sec. 7, T. 112 N., R. 40 W.

A1—0 to 11 inches; black (5Y 2/1) silty clay loam; weak very fine subangular blocky structure; sticky; many roots; slight effervescence; mildly alkaline; gradual smooth boundary.

A12—11 to 18 inches; mixed very dark gray (5Y 3/1), black (5Y 2/1), and dark gray (5Y 4/1) silty clay loam; weak fine and medium subangular blocky structure; friable, sticky; strong effervescence; moderately alkaline; gradual smooth boundary.

A13—18 to 38 inches; black (5Y 2/1) silty clay loam; weak very fine subangular blocky structure; friable, sticky; many gypsum crystals in the lower part; slight effervescence; mildly alkaline; gradual smooth boundary.

Cg—38 to 60 inches; very dark gray (5Y 3/1) silty clay loam; massive; sticky; high content of gypsum and soluble salts in the upper part; few soft white 5- to 10-millimeter lime masses; slight and strong effervescence; moderately alkaline.

The A1 horizon ranges from 24 to 38 inches in thickness and from silty clay loam to silt loam. A transitional AC horizon occurs in many pedons. It is less than 15 inches thick, is dark gray or very dark gray, and ranges from silty clay loam to clay loam. The C horizon is silty clay loam or clay loam. Some pedons have stratified sand and gravel below a depth of 40 inches. Reaction is mildly alkaline or moderately alkaline throughout.

Rolfe series

The Rolfe series consists of poorly drained, slowly permeable soils. These soils formed in medium textured to fine textured, stone-free glacial material in shallow, closed depressions on uplands and the lowland plain. Slope is 0 to 1 percent.

Rolfe soils are near Canisteo soils and are in depressions similar to those occupied by Glencoe soils. Canisteo soils are calcareous, are less clayey than Rolfe soils, and are at a slightly higher elevation. Glencoe soils lack the A2 horizon and the fine textured B horizon characteristic of Rolfe soils and are less acid.

Typical pedon of Rolfe loam, 1,700 feet west and 725 feet north of the southeast corner of sec. 22, T. 113 N., R. 43 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak very fine granular structure; friable; medium acid; abrupt smooth boundary.

A2—8 to 20 inches; dark gray (10YR 4/1) and very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) crushed; few fine distinct olive brown (2.5Y 4/4) mottles; moderate medium platy structure parting to weak fine subangular blocky; friable; common fine continuous tubular pores; slightly acid; clear smooth boundary.

B21tg—20 to 26 inches; very dark gray (10YR 3/1) clay; strong fine and very fine angular and subangular blocky structure; firm; few thin clay films on faces of peds; slightly acid; clear smooth boundary.

B22tg—26 to 32 inches; dark grayish brown (2.5Y 4/2) clay; common fine distinct yellowish brown (10YR 5/6) mottles; moderate fine and medium angular and subangular blocky structure; firm; about 2 per-

cent coarse fragments; common medium clay films on vertical faces of peds; slightly acid; gradual smooth boundary.

B23g—32 to 39 inches; olive gray (5Y 5/2) clay loam; common fine distinct light olive brown (2.5Y 5/4) mottles; moderate fine and medium subangular blocky structure; firm; about 2 percent coarse fragments; neutral; gradual smooth boundary.

B3g—39 to 51 inches; olive gray (5Y 5/2) clay loam; common fine distinct light olive brown (2.5Y 5/4) mottles; weak fine and medium subangular blocky structure; friable; about 2 percent coarse fragments; neutral; gradual smooth boundary.

Cg—51 to 60 inches; olive (5Y 4/3) loam; common medium distinct light olive brown (2.5Y 5/4) mottles; structureless; friable; about 5 percent coarse fragments; few strata of sand and gravel; slight effervescence; mildly alkaline.

The thickness of the solum is 40 to 50 inches and generally is the same as the depth to free lime. The solum typically is slightly acid but ranges from medium acid to neutral.

The A1 horizon is loam or silt loam 7 to 12 inches thick. It ranges from black to very dark gray. The A2 horizon also is loam or silt loam. It is dark gray, gray, dark grayish brown, or grayish brown. The B2 horizon is silty clay, clay, or heavy silty clay loam or clay loam and is gray and dark gray or olive gray. The B3 and C horizons are dominantly clay loam or loam, but some pedons have thin strata that are silty or sandy. The dominant colors are olive, olive gray, light olive gray, and gray.

Seaforth series

The Seaforth series consists of moderately well drained, moderately permeable, calcareous soils. These soils formed in medium textured glacial till on the lowland plain. Slope ranges from 1 to 3 percent.

Seaforth soils are near Canisteo and Ves soils. They are similar to Hamerly soils. Canisteo soils are downslope from Seaforth soils and are poorly drained. Ves soils are upslope from Seaforth soils and are well drained. Hamerly and Seaforth soils are in similar positions on the landscape, but Hamerly soils have a lower mean annual soil temperature.

Typical pedon of Seaforth loam, 1 to 3 percent slopes, 500 feet west and 40 feet south of the northeast corner of sec. 9, T. 111 N., R. 40 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; friable, hard; about 3 percent coarse fragments; slight effervescence; mildly alkaline; abrupt smooth boundary.

A3—9 to 15 inches; very dark gray (10YR 3/1) loam, very dark grayish brown (2.5Y 3/2) crushed; moderate very fine and fine subangular blocky structure; friable; many black (10YR 4/1) and grayish brown (2.5Y 5/2) worm casts and fillings in root channels; about 3 percent coarse fragments; mostly slight effervescence, strong effervescence in spots; moderately alkaline; clear irregular boundary.

B2ca—15 to 24 inches; grayish brown (2.5Y 5/2) loam; weak and moderate fine and medium subangular blocky structure; friable; many soft masses and threadlike accumulations of lime; about 5 percent coarse fragments; violent effervescence; moderately alkaline; gradual smooth boundary.

C1—24 to 36 inches; grayish brown (2.5Y 5/2) loam; common medium faint light olive brown (2.5Y 5/4) mottles; weak medium and coarse subangular blocky structure; friable; about 5 percent coarse fragments; violent effervescence; moderately alkaline; gradual smooth boundary.

C2—36 to 60 inches; olive brown (2.5Y 4/4) loam; common medium distinct gray (5Y 5/1) mottles; massive; friable; few soft masses of lime; few segregations of iron oxide; about 7 percent coarse fragments; strong effervescence; moderately alkaline.

The solum is 20 to 28 inches thick. The solum and the C horizon typically are loam, but some pedons have subhorizons of light clay loam, silt loam, sandy clay loam, or heavy sandy loam. Fragments of shale are common or many; 20 to more than 50 percent of the coarse fragments that are 2 to 5 millimeters in size are shale fragments. The solum and the C horizon dominantly are mildly alkaline or moderately alkaline, but in some pedons the upper 10 inches is neutral.

The A horizon is black or very dark gray and is about 7 to 16 inches thick. In most pedons the soil material and worm casts in the A3 horizon have colors similar to those of the B horizon. The B horizon ranges from light brownish gray to olive brown. The C horizon is grayish brown, olive gray, olive, or olive brown.

Sinai series

The Sinai series consists of moderately well drained, slowly permeable soils. These soils formed in fine textured and moderately fine textured glacial lacustrine sediments on ice-walled lake plains in the uplands. Slope ranges from 1 to 3 percent.

Sinai soils are near Fulda and Poinsett soils. Fulda soils are at a lower elevation than Sinai soils and are poorly drained. Poinsett soils are at a higher elevation than Sinai soils, have a thinner mollic epipedon and a more brownish B horizon, and contain more silt and less clay.

Typical pedon of Sinai silty clay, 1 to 3 percent slopes, 1,530 feet south and 70 feet east of the northwest corner of sec. 25, T. 110 N., R. 43 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay; weak and moderate very fine and fine subangular blocky structure; hard, firm; slightly acid; abrupt smooth boundary.

A12—8 to 14 inches; black (10YR 2/1) silty clay; strong very fine angular and subangular blocky structure; firm; slightly acid; clear smooth boundary.

A3—14 to 17 inches; mixed black (10YR 2/1) and very dark grayish brown (2.5Y 3/2) silty clay, very dark gray (10YR 3/1) crushed; moderate and strong very fine angular and subangular blocky structure; firm; slightly acid; gradual smooth boundary.

B21—17 to 27 inches; mixed very dark grayish brown (2.5Y 3/2) and brown (10YR 4/3) silty clay, dark grayish brown (2.5Y 4/2) crushed; moderate medium prismatic structure parting to moderate and strong fine angular blocky; firm; few very dark grayish brown (10YR 3/2) tongues; few very fine iron oxide stains; few thin clay films on vertical faces of peds; neutral; gradual smooth boundary.

B22—27 to 33 inches; dark grayish brown (2.5Y 4/2) silty clay; common fine faint grayish brown (2.5Y 5/2) mottles; weak very fine and fine subangular blocky structure; firm; common iron oxide stains; neutral; clear smooth boundary.

C1ca—33 to 47 inches; light olive brown (2.5Y 5/6) silty clay loam; common medium distinct olive gray (5Y 5/2) mottles; friable; about 3 percent coarse fragments; few soft calcium carbonate accumulations; few 10- to 25-millimeter calcium carbonate concretions; violent effervescence; moderately alkaline; gradual smooth boundary.

C2—47 to 60 inches; light olive gray (5Y 6/2) silty clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; friable; about 1 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 34 inches. The A horizon is 16 to 22 inches thick. Very dark gray tongues are few to common in the part of the B horizon within a depth of 30 inches. The A and B horizons are typically silty clay but range to silty clay loam. The B horizon is commonly very dark grayish brown, dark grayish brown, olive brown, or light olive brown. The C horizon has the same textures as the A and B horizons, but in addition it ranges to silt loam, clay loam, or loam below a depth of 40 inches.

Sioux series

The Sioux series consists of excessively drained, rapidly permeable soils. These soils formed in gravelly and sandy glacial outwash on terrace escarpments and upland ridges. Slope ranges from 2 to 40 percent.

Sioux soils are near Arvilla and Fordville soils and are similar to Buse soils in having a weakly expressed profile. Arvilla and Fordville soils have a thicker solum than Sioux soils. Also, Fordville soils have a finer textured solum. Buse soils formed in loam glacial till.

Typical pedon of Sioux gravelly sandy loam, in an area of Sioux soils, 2 to 40 percent slopes, 100 feet south and 200 feet west of the northeast corner of sec. 11, T. 110 N., R. 43 W.

A1—0 to 11 inches; black (10YR 2/1) gravelly sandy loam, very dark gray (10YR 3/1) dry; very weak very fine subangular blocky structure; very friable; about 15 percent coarse fragments, mostly gravel; slight effervescence; mildly alkaline; clear wavy boundary.

C1—11 to 16 inches; mixed dark grayish brown (10YR 4/2) and dark yellowish brown (10YR 3/4) gravelly coarse sand, dark brown (10YR 4/3) and dark yellowish brown (10YR 4/4) dry; single grained; loose; about 15 percent coarse fragments, mostly gravel; strong effervescence; mildly alkaline; clear wavy boundary.

IIC2—16 to 60 inches; mixed dark yellowish brown (10YR 4/4) and grayish brown (10YR 5/2) very gravelly coarse sand, light yellowish brown (10YR 6/4) and yellowish brown (10YR 5/4) dry; single grained; loose; calcium carbonate coatings on bottom and sides of pebbles in the upper part; about 50 percent gravel and cobblestones; strong effervescence; mildly alkaline.

The solum is 7 to 12 inches thick. The A horizon ranges from gravelly loamy coarse sand to loam and from black to very dark gray. It generally is calcareous, but in a few pedons the upper part is noncalcareous. The percentage of sand, gravel, and cobbles in the C horizon varies.

Storden series

The Storden series consists of well drained, moderately permeable soils. These soils formed in medium textured glacial till on the lowland plain and uplands. Slope ranges from 5 to 18 percent.

Storden soils are similar to Buse soils and are near Everly and Ves soils. Buse soils have a slightly lower mean annual soil temperature than Storden soils and have a mollic epipedon. Everly and Ves soils have a darker colored A horizon than Storden soils. They also differ from those soils in having a noncalcareous A horizon and in having a B horizon.

Typical pedon of Storden loam, in an area of Storden-Ves loams, 5 to 12 percent slopes, eroded, 2,270 feet east and 30 feet north of the southwest corner of sec. 11, T. 111 N., R. 41 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam; weak very fine subangular blocky structure; hard, friable; about 3 percent coarse fragments; strong effervescence; mildly alkaline; abrupt smooth boundary.

C1—8 to 13 inches; grayish brown (10YR 5/2) loam; weak fine and very fine subangular blocky structure; friable; about 3 percent coarse fragments; few fragments of shale; strong effervescence; mildly alkaline; clear smooth boundary.

C2—13 to 23 inches; brown (10YR 5/3) loam; weak medium subangular blocky structure; friable; about 2 percent coarse fragments; few masses of lime; violent effervescence; moderately alkaline; clear smooth boundary.

C3—23 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; about 5 percent coarse fragments; few shale fragments; few iron oxide stains; thin manganese oxide coatings on vertical fractures; strong effervescence; mildly alkaline.

The thickness of the solum commonly is the same as that of the A horizon, which is 7 to 10 inches. The texture of the A and C horizons typically is loam, but some pedons have subhorizons of light clay loam. Typically, all horizons are calcareous, but in some uncultivated areas part or all of the A horizon lacks free lime. In most uncultivated areas, an AC horizon 3 to 6 inches thick has formed, mostly as the result of mixing by earthworms and plant roots. Some pedons have a thin, slightly calcareous, weakly expressed B horizon. Reaction is mildly alkaline or moderately alkaline throughout.

Svea series

The Svea series consists of moderately well drained, moderately permeable soils. These soils formed in medium textured glacial till on glaciated uplands. Slope ranges from 1 to 3 percent.

Svea soils are near Barnes soils and are similar to Normania soils. Barnes soils have a thinner mollic epipedon than Svea soils, are on higher lying slopes, and are well drained. Normania soils have a slightly higher mean annual soil temperature than Svea soils.

Typical pedon of Svea loam, 1 to 3 percent slopes, 500 feet south and 45 feet west of the northeast corner of SW1/4 sec. 29, T. 110 N., R. 42 W.

Ap—0 to 8 inches; black (10YR 2/1) loam; weak very fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

A12—8 to 16 inches; black (10YR 2/1) loam; moderate fine and very fine subangular blocky structure; friable; neutral; clear smooth boundary.

A3—16 to 21 inches; mixed very dark gray (10YR 3/1), black (10YR 2/1), very dark grayish brown (10YR 3/2), and olive brown (2.5Y 4/4) loam, very dark grayish brown (10YR 3/2) crushed; moderate very fine subangular blocky structure; friable; many worm casts; neutral; clear irregular boundary.

B2—21 to 31 inches; dark grayish brown (2.5Y 4/2) loam; weak medium prismatic structure parting to weak fine subangular blocky; friable; few dark grayish brown (10YR 4/2) worm casts; mildly alkaline; clear smooth boundary.

B3ca—31 to 37 inches; olive brown (2.5Y 4/4) loam; weak fine subangular blocky structure; friable; about 8 percent coarse fragments; slight effervescence; mildly alkaline; clear smooth boundary.

C1ca—37 to 47 inches; light olive brown (2.5Y 5/4) loam; common fine faint grayish brown (2.5Y 5/2) mottles; friable; about 20 percent coarse fragments; few fine iron oxide concretions; few soft white masses of calcium carbonate; few calcium carbonate coatings on bottom of pebbles; strong effervescence; mildly alkaline; gradual smooth boundary.

C2—47 to 60 inches; light olive brown (2.5Y 5/4) loam; common medium faint grayish brown (2.5Y 5/2) mottles; firm; about 8 percent coarse fragments; soft reddish iron oxide masses; strong effervescence; mildly alkaline.

The solum typically is loam, but some pedons have subhorizons of light clay loam or sandy clay loam. The A horizon is 16 to 21 inches thick. The A3 horizon, which is as much as 6 inches thick in some pedons, is very dark gray or very dark grayish brown. It is lacking in some pedons. Free lime in the form of soft accumulations and hard concretions is in the B3ca and C1ca horizons. Depth to free lime ranges

from 24 to 36 inches. The C horizon typically is loam but ranges to light clay loam.

Sverdrup series

The Sverdrup series consists of somewhat excessively drained soils that are moderately rapidly permeable. These soils formed in moderately coarse textured and coarse textured glacial material on lowland plains, lake plains, and uplands. Slope ranges from 0 to 6 percent.

Sverdrup soils are near Arvilla and Fordville soils. Arvilla soils have a gravelly coarse sand IIC horizon. Fordville soils are finer textured than Sverdrup soils, have a thicker solum, and have a gravelly and sandy IIC horizon.

Typical pedon of Sverdrup sandy loam, 2 to 6 percent slopes, 140 feet east and 85 feet south of the northwest corner of sec. 23, T. 113 N., R. 42 W.

Ap—0 to 9 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

B21—9 to 14 inches; very dark grayish brown (10YR 3/2) sandy loam; weak coarse prismatic structure parting to weak and moderate medium and coarse subangular blocky; friable; slightly acid; clear smooth boundary.

B22—14 to 21 inches; dark yellowish brown (10YR 3/4) sandy loam; weak medium subangular blocky structure; very friable; few very dark brown (10YR 2/2) loamy sand krotovina in the lower part; slightly acid; abrupt smooth boundary.

B3—21 to 32 inches; dark yellowish brown (10YR 4/4) loamy sand; single grained; loose; about 5 percent gravel consisting mostly of shale particles; neutral; clear smooth boundary.

C—32 to 60 inches; mixed brown (10YR 5/3) and pale brown (10YR 6/3) sand; single grained; loose; few shale fragments; few bands with coatings of reddish iron oxide on sand particles; about 5 percent gravel; slight effervescence; mildly alkaline.

The depth to free lime varies within short horizontal distances; it is typically 20 to 39 inches but ranges from 15 to 40 inches. The depth to loamy fine sand or coarser sand ranges from 12 to 24 inches. The A horizon is sandy loam or fine sandy loam. The B2 horizon ranges from fine sandy loam to loamy sand. The C horizon is sand or fine sand.

Urness series

The Urness series consists of very poorly drained, moderately permeable and moderately slowly permeable, calcareous soils. These soils formed in medium textured silty lake sediments in drained lakes and ponds. Slope is 0 to 1 percent.

Urness, Glencoe, Oldham, and Quam soils are in similar positions on the landscape. Glencoe and Quam soils have a solum that is leached of free carbonates and contain less organic matter than Urness soils. Oldham soils are finer textured than Urness soils and also contain less organic matter.

Typical pedon of Urness silt loam, 1,320 feet south and 120 feet west of the northeast corner of sec. 16, T. 110 N., R. 42 W.

Lcop—0 to 9 inches; black (10YR 2/1) silt loam coprogenous earth, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; hard, friable; few fragments of snail shells; violent effervescence; moderately alkaline; abrupt smooth boundary.

Lco2—9 to 22 inches; black (10YR 2/1) silt loam coprogenous earth; common medium distinct very dark grayish brown (2.5Y 3/2) mottles; weak fine platy structure; friable; many brown stains and mottles; few fragments of snail shells; violent effervescence; mildly alkaline; gradual smooth boundary.

Lco3—22 to 29 inches; very dark gray (10YR 3/1) silt loam coprogenous earth; common medium distinct very dark grayish brown (2.5Y 3/2) mottles; strong vertical cleavage; friable; few fragments of snail shells; violent effervescence; mildly alkaline; gradual smooth boundary.

Lco4—29 to 44 inches; very dark gray (5Y 3/1) silty clay loam coprogenous earth; common medium distinct very dark grayish brown (2.5Y 3/2) mottles; vertical cleavage; friable; few fragments of snail shells; violent and strong effervescence; mildly alkaline; gradual smooth boundary.

IIC1g—44 to 60 inches; olive (5Y 4/3) silty clay loam; many medium distinct very dark grayish brown (2.5Y 3/2) mottles; friable; strong effervescence; mildly alkaline.

The highly organic lake sediments, or coprogenous earth, range from 24 to 48 inches in thickness. They have few to many snail shells and clam shells. They are black or very dark gray and range to dark gray when dry. The content of organic matter is 10 to 20 percent. The IIC horizon is silty clay loam or silt loam lake-deposited sediments or is clay loam or loam glacial till.

Vallers series

The Vallers series consists of poorly drained, calcareous soils that are moderately slowly permeable. These soils formed in medium textured glacial material on uplands. Slope ranges from 0 to 2 percent.

Vallers soils are similar to Canisteo soils and are near Flom and Quam soils. Canisteo soils have a slightly higher mean annual soil temperature than Vallers soils. Flom and Vallers soils are in similar positions on the landscape. Flom soils are noncalcareous in the upper part of the solum. Quam soils are in depressions. They have a thicker mollic epipedon than Vallers soils and have a solum that has been leached of free carbonates.

Typical pedon of Vallers clay loam, 1,500 feet south and 100 feet west of the northeast corner of sec. 10, T. 110 N., R. 42 W.

Ap—0 to 8 inches; black (N 2/0) clay loam; weak very fine granular structure; hard, friable, sticky; few fine threads of gypsum; about 2 percent coarse fragments; strong effervescence; mildly alkaline; abrupt smooth boundary.

A12—8 to 12 inches; black (N 2/0) clay loam; weak very fine subangular blocky structure; hard, friable, sticky; few fine threads of gypsum; about 2 percent coarse fragments; strong effervescence; mildly alkaline; clear irregular boundary.

A3—12 to 15 inches; mixed very dark gray (N 3/0) and dark grayish brown (2.5Y 4/2) clay loam, dark gray (N 4/0) crushed; weak very fine and fine subangular blocky structure; friable; about 2 percent coarse fragments; violent effervescence; mildly alkaline; clear irregular boundary.

B2gca—15 to 25 inches; dark grayish brown (2.5Y 4/2) clay loam; few medium faint olive brown (2.5Y 4/4) mottles; weak very fine and fine subangular blocky structure; friable; few very dark gray (10YR 3/1) worm casts; about 4 percent coarse fragments; many fine crystals of gypsum; violent effervescence; moderately alkaline; gradual irregular boundary.

C1g—25 to 42 inches; grayish brown (2.5Y 5/2) loam; common medium faint light olive brown (2.5Y 5/6) mottles; weak fine subangular blocky structure; friable; about 3 percent coarse fragments; violent effervescence; moderately alkaline; clear smooth boundary.

C2g—42 to 60 inches; light brownish gray (2.5Y 6/2) loam; common medium faint light olive brown (2.5Y 5/6) mottles; very weak fine and medium subangular blocky structure; friable; about 5 percent coarse fragments; violent effervescence; moderately alkaline.

The A1 horizon typically is clay loam, but it ranges from loam to silty clay loam. It is 10 to 16 inches thick and ranges from black to very dark gray. Effervescence is slight to violent. The A3 horizon is very dark gray, dark gray, olive gray, dark grayish brown, or very dark grayish brown. The B horizon has a similar range in thickness and in color. The C horizon is glacial till that typically is loam but ranges to light clay loam. It ranges from gray to olive gray, to light olive, or to grayish brown. Few to many gypsum crystals are in the B2 and C horizons in some pedons.

Ves series

The Ves series consists of well drained, moderately permeable soils. These soils formed in medium textured glacial till on the lowland plain. Slope ranges from 1 to 18 percent.

Ves soils are similar to Barnes soils and are near Canisteo, Seaforth, and Storden soils. Barnes soils have a slightly lower mean annual soil temperature than Ves soils. Canisteo and Seaforth soils have a calcareous solum. They are at a lower elevation than Ves soils and are not so well drained. Storden soils have a lighter colored A horizon than Ves soils and have a weakly expressed solum. They also differ from those soils in having a calcareous A horizon.

Typical pedon of Ves loam, 1 to 4 percent slopes, 1,800 feet south and 100 feet east of the northwest corner of sec. 7, T. 113 N., R. 41 W.

Ap—0 to 8 inches; black (10YR 2/1) loam; weak very fine subangular blocky structure; friable; about 3 percent coarse fragments; neutral; abrupt smooth boundary.

A3—8 to 11 inches; very dark gray (10YR 3/1) loam; moderate very fine and fine subangular blocky structure; friable; few dark grayish brown (10YR 4/2) worm casts; about 3 percent coarse fragments; neutral; clear irregular boundary.

B21—11 to 15 inches; dark yellowish brown (10YR 4/4) loam; weak and moderate medium prismatic structure parting to weak and moderate fine and medium subangular blocky; friable; many very dark gray (10YR 3/1) worm casts; about 5 percent coarse fragments, mostly shale; neutral; clear smooth boundary.

B22—15 to 21 inches; brown (10YR 4/3) loam; weak and moderate medium prismatic structure parting to weak medium subangular blocky; friable; about 5 percent coarse fragments, mostly shale; neutral; clear wavy boundary.

B3ca—21 to 36 inches; light olive brown (2.5Y 5/4) loam; weak medium subangular blocky structure; friable; many soft white masses and threadlike accumulations of lime; about 5 percent coarse fragments; strong and violent effervescence; moderately alkaline; gradual smooth boundary.

C—36 to 60 inches; olive brown (2.5Y 4/4) loam; common medium faint grayish brown (2.5Y 5/2) mottles; massive; friable; few 3- to 10-millimeter soft yellowish red accumulations of iron oxide; about 8 percent coarse fragments; few shale fragments; strong effervescence; moderately alkaline.

The depth to free lime typically is 18 to 22 inches, but it ranges from 14 to 33 inches. The solum and the C horizon typically are loam, but some pedons have subhorizons of clay loam, silt loam, sandy clay loam, or heavy sandy loam. Shale fragments are common to abundant; 20 to more than 50 percent of the coarse fragments that are 2 to 5 millimeters in size are shale fragments. The A and B2 horizons typically are neutral, but they range from slightly acid to mildly alkaline.

Depending on the slope and the extent of erosion, the A horizon is 6 to 16 inches thick. It ranges from black to very dark gray. In most pedons the A3 horizon has soil material and worm casts that are similar to those of the upper part of the B2 horizon. The B2 horizon is dark brown, brown, or dark yellowish brown. The C horizon is typically light olive brown but ranges from light yellowish brown to olive brown.

Wilmonton series

The Wilmonton series consists of moderately well drained, moderately slowly permeable soils. These soils formed in moderately fine textured glacial till in the uplands. Slope ranges from 0 to 2 percent.

Wilmonton soils are similar to Aastad soils and are near Everly and Letri soils. Aastad soils have a slightly lower mean annual soil temperature than Wilmonton soils. Everly soils are upslope from Wilmonton soils, have a thinner mollic epipedon, and are well drained. Letri soils are downslope from Wilmonton soils and are poorly drained.

Typical pedon of Wilmonton clay loam, 0 to 2 percent slopes, 575 feet west and 145 feet north of the southeast corner of sec. 24, T. 109 N., R. 40 W.

Ap—0 to 11 inches; black (10YR 2/1) clay loam; weak very fine subangular blocky structure; friable; about 2 percent coarse fragments; abrupt smooth boundary.

A12—11 to 18 inches; black (10YR 2/1) clay loam; weak to moderate very fine and fine subangular blocky structure; friable; about 2 percent coarse fragments; slightly acid; clear irregular boundary.

B1—18 to 24 inches; dark grayish brown (10YR 4/2) clay loam; moderate fine and medium subangular blocky structure; firm; about 2 percent coarse fragments; common very dark gray (10YR 3/1) worm casts; slightly acid; clear smooth boundary.

B22—24 to 31 inches; dark grayish brown (2.5Y 4/2) clay loam; common medium faint olive brown (2.5Y 4/4) mottles; weak medium prismatic structure parting to weak medium and fine subangular blocky; firm; about 3 percent coarse fragments; slightly acid; gradual smooth boundary.

C1gca—31 to 37 inches; dark grayish brown (2.5Y 4/2) clay loam; common medium faint grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4) mottles; weak fine subangular blocky structure; firm; about 3 percent coarse fragments; few concretions and soft masses of lime; few reddish stains and accumulations of iron oxides; strong effervescence; moderately alkaline; clear smooth boundary.

C2—37 to 60 inches; light olive brown (2.5Y 5/4) clay loam; many medium faint grayish brown (2.5Y 5/2) mottles; firm to friable; massive; about 4 percent coarse fragments; few concretions and soft masses of lime; few reddish stains and accumulations of iron oxides; strong effervescence; moderately alkaline.

The solum is typically 24 to 35 inches thick but ranges from 20 to 40 inches. The thickness of the solum and the depth to carbonates generally are the same. The solum typically is 26 to 35 percent clay and is clay loam. The C horizon is 25 to 30 percent clay. It is typically loam, but in some pedons it is light clay loam.

The A1 horizon is 8 to 16 inches thick. A very dark gray, very dark grayish brown, or very dark brown A3 or B1 horizon is in most pedons. The B horizon is dark grayish brown, olive brown, or very dark grayish brown. It is firm to friable. The C horizon commonly is dark grayish brown, light olive brown, grayish brown, or olive.

Classification of the soils

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965.

Readers interested in further details about the system should refer to "Soil taxonomy" (*8*).

The system of classification has six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the classification is based on the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In table 17, the soils of the survey area are classified according to the system. Categories of the system are discussed in the following paragraphs.

ORDER. Ten soil orders are recognized as classes in the system. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders based primarily on properties that influence soil genesis and are important to plant growth or that are selected to reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquoll (*Aqu*, meaning water, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of expression of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and a prefix that suggests something about the properties of the soil. An example is Haplaquolls (*Hapl*, meaning simple horizons, plus *aquoll*, the suborder of Mollisols that have an aquic moisture regime).

SUBGROUP. Each great group may be divided into three subgroups: the central (typic) concept of the great groups, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extragrades, which have some properties that are representative of the great groups but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that is thought to typify the great group. An example is Typic Haplaquolls.

FAMILY. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineral content, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, soil slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiae. An example is fine-loamy, mixed, mesic Typic Haplaquolls.

SERIES. The series consists of soils that formed in a particular kind of material and have horizons that, except for texture of the surface soil or of the underlying substratum, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineral and chemical composition.

Formation of the soils

Soil forms through the physical and chemical weathering of deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of soil formation have acted on the soil material.

The following paragraphs relate the factors of soil formation to the soils in the survey area.

Parent material

The soils of Lyon County formed mostly in glacial till or in material sorted out of the till by the action of water. About 80 percent of the soils formed in glacial till, about 10 percent in alluvium and colluvium, about 5 percent in or over sandy and gravelly outwash, and about 5 percent in lacustrine sediments (fig. 14). The Des Moines lobe of the Wisconsin glaciation is the most recent glacier that covered the county (*5*, *9*). The following paragraphs describe the parent material as it occurs within major geomorphic areas in the county.

Altamont moraine.—This recessional moraine of the Des Moines lobe is in the southwestern part of the county. The landscape is undulating and rolling. Most of the till is loam. Barnes, Buse, Svea, and Flom soils are the major soils formed in this till.

Several distinctive geomorphic landforms occur on the Altamont moraine. These include ice-walled lake plains and dead-ice moraines.

The ice-walled lake plains consist of flat-topped hills that typically are the highest part of the landscape. Stratified silty and clayey sediments are on these nearly level and gently sloping hilltops. These sediments are probably of lacustrine origin and were deposited in the temporary lakes that formed during the glacial periods (*4*). Fulda, Sinai, and Poinsett are the major soils that formed on this landscape.

Several dead-ice moraines are evident. In these areas the glacial ice was blanketed by superglacial till (*3*). This till has a high water content from the melting ice; wher-

ever the till blanket was thin, the dead ice melted more rapidly, resulting in slumping and flowing of the supraglacial till and an irregular, complex topography. Barnes and Buse are the major soils on dead-ice moraines. Stony spots and pockets of sand and gravel where Sioux and Arvilla soils formed also are common.

Melt water channels and outwash plains.—A series of gravelly melt water channels and outwash plains is on the outer side of the Coteau slope. It formed mostly through the action of streams flowing off the receding glacial ice. Outwash material was deposited on small, discontinuous terraces along most of the major streams and in pockets or in layers over the glacial till on uplands throughout the county. Sand and gravel also were deposited along the melting frost of the receding glacial ice. The soils in these areas formed in 10 to 40 inches of loamy sediments and in the underlying sandy and gravelly sediments. Arvilla, Fordville, Sioux, and Sverdrup soils are the principal soils that formed in this material.

Coteau slope.—The Coteau slope is the first slope on the northeast flank of the Coteau des Prairies. In Lyon County it is 6 to 8 miles wide and extends diagonally across the county from the northwest to the southwest. It borders on melt water channels and minor outwash plains on its southwest side and on an ice marginal lake plain on its northeast side. The increase in elevation is about 50 feet per mile. Nearly parallel drainageways that are 25 to 50 feet deep dissect the Coteau slope at intervals of a half mile to a mile. The slope resembles a stairway: the large areas of nearly level Aastad soils are the treads and the areas of undulating and rolling Forman soils are the risers (*5*).

The glacial till is the most clayey material in the county. It is clay loam or loam that is high in content of clay. Forman and Aastad soils formed in this till. Very few areas of sandy and gravelly soils are evident.

Ice marginal lake plain.—This geomorphic area, which is only 1 mile to 2 miles wide, lies along the northeast side of the Coteau des Prairies. It formed between the Coteau slope and the melting glacial ice. Most of the original lacustrine sediments were silty clay loam and silty clay, but these deposits mostly have been covered by alluvium deposited by the rivers and creeks flowing out of the Coteau slope in the steeper areas. These sediments range from loamy to sandy and gravelly. The major soils formed in the silty and clayey sediments are Oldham, Bearden, and Colvin soils. Marysland and Malachy soils formed in the loamy and sandy and gravelly sediments.

Lowland plain.—The lowland plain is a glacial ground moraine or till plain that extends northeast from the lake plain to the Minnesota River. This till plain consists almost entirely of irregularly shaped low knolls, most of which rise 1 foot to 10 feet above the floor of the till plain. The till, which is the youngest in the county, is loam that contains many, unweathered, gray and green shale fragments. Seaforth, Normania, and Ves soils formed in this material.

Flood plains.—Alluvial material has been deposited along rivers and creeks and in the high overflow channels between some of the rivers and creeks. These sediments in most places are several feet thick and are dark colored and calcareous. They are mainly silty clay loam or loam. Lamoure, La Prairie, and Rauville soils formed in alluvial material.

In some areas on the flood plain, especially in the overflow channels, the parent material resembles that on the lake plain. Soils that are associated with the lake plain formed in these areas.

Climate

Lyon County has a subhumid, continental climate characterized by cold winters and hot summers. The climate has had a pronounced effect on soil formation. Freezing of the soil during winter slows the soil-forming processes. Alternate freezing and thawing, especially in spring, plays a part in the development of soil structure. Freezing and thawing also helps to disintegrate parts of the glacial debris, and frost heaving helps to mix the soil material. Rainfall has affected the leaching of lime. The depth to which free lime has been leached has largely determined the thickness of the solum.

Climate was responsible to a large extent for the prairie vegetation. As a result of this vegetation, the soils have a dark colored surface layer. Prairie vegetation and cool temperatures promote the accumulation of organic matter. Most of the soils in the county have a high organic-matter content. More details about the climate are given in the section "General nature of the county."

Plant and animal life

The native vegetation of Lyon County consisted mainly of tall and mid prairie grasses, depending on the soil, the drainage, and other site factors. Prairie cordgrass, reedgrass, switchgrass, and sedges grew on wet sites. Bluestem, green needlegrass, porcupinegrass, Canada wildrye, indiangrass, needle-and-thread, and side-oats grama grew on the better drained sites. A variety of flowers flourished on the native prairies, including aster, goldenrod, sunflower, blazing star, clover, rose, lily, harebell, phlox, and gentian.

The growth of plants in freshly deposited glacial till started soil formation in Lyon County. Plant roots loosen the soil and bring minerals up from the parent material. The plants die and decay, thus returning organic matter and plant nutrients to the soil.

Earthworms are probably the major animals affecting soil formation. The subsurface horizon of many soils contains worm casts of surface and subsoil material. Burrowing animals also mix soil material from various horizons and bring fresh parent material to the surface.

Man influences soil formation. Farming has increased the action of some of the soil-forming processes. Accelerated erosion of the surface layer has occurred on

some of the sloping soils. Some of the lower lying soils have gained deposits of eroded material. The strong granular structure of the surface layer has been weakened or destroyed in many of these soils. The surface layer of most of the well drained soils has become browner as a result of mixing with the subsoil and reduction of the amount of organic matter. Leaching of many soils has been slowed as a result of increased runoff and reduced infiltration. Man's activities, particularly in altering drainage conditions, maintaining fertility, and changing the kinds of vegetation, continue to have an important effect on soil formation.

Relief

In Lyon County relief ranges from nearly level to very steep. Relief is the most important factor in the formation of different soils in uniform parent material. Soils that have fairly mature soil profiles, in which the horizons are distinct, formed where drainage is good and the slope is gentle. Steep soils show little evidence of soil formation, mostly because runoff is excessive. Runoff reduces the amount of water that can leach the soil and the amount that plants can use. Many steep soils, therefore, are droughty, have indistinct horizons, and support a poor cover of plants.

Topographic position is a key to the kind of soil and the soil drainage class at any place on the landscape. For example, the location of Buse, Barnes, Svea, Flom, and Quam soils, which make up the Barnes drainage sequence, generally can be predicted. Each of these soils occupies a distinctive part of the landscape. The well drained, steep Buse soils are on convex side slopes; the well drained, gently undulating Barnes soils are on the more gentle convex slopes and on hilltops; the moderately well drained, nearly level Svea soils are at lower elevations than Barnes soils or in plane or slightly concave, nearly level areas surrounded by Barnes soils; the poorly drained Flom soils are in drainageways and on nearly level, wet flats; and the very poorly drained Quam soils are in depressions and very wet drainageways.

Time

The time required for soil formation depends to a large extent on the other factors. In areas where relief and drainage are favorable, enough time has elapsed for the soils to have mature profiles. Steep soils have immature or thin profiles because the soil-forming processes have not been effective. Soils formed in alluvium along the streams are immature or weakly developed because the material is young. Fresh deposits are added to the alluvium almost annually and distinct, mature horizons have not had time to form.

In the geological sense, all of the soils in the county are very young. In most parts of the county, soil-forming processes have been active for probably only about 8,000 to 12,000 years.

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Glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	More than 9

Bottom land. The normal flood plain of a stream, subject to frequent flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coat, clay skin.

Coarse fragments. Mineral or rock particles up to 3 inches (2 millimeters to 7.5 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the bases of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures is difficult.

Complex, soil. A map unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Cutbanks cave. Unstable walls of cuts made by earthmoving equipment. The soil sloughs easily.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

Excess fines. Excess silt and clay. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime. Excess carbonates. Excessive carbonates, or lime, restrict the growth of some plants.

Fast intake. The rapid movement of water into the soil.

Favorable. Favorable soil features for the specified use.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fine textured (heavy textured) soil. Sandy clay, silty clay, and clay.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; *November-May*, for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered flooding.

Foot slope. The inclined surface at the base of a hill.

Frost action. Freezing and thawing of soil moisture. Frost action can damage structures and plant roots.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by melt water as it flows from glacial ice.

Glacial till (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gypsum. Hydrous calcium sulphate.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon most of which was originally part of a B horizon.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered, but are separate factors in predicting runoff. Soils are assigned to four

groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants are those that follow disturbance of the surface.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. Inadequate strength for supporting loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Moderately coarse textured (moderately light textured) soil. Sandy loam and fine sandy loam.

Moderately fine textured (moderately heavy textured) soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Types are terminal, lateral, medial, and ground.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse* more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three single variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Organic-matter content. Values in this report are based on upper 10 inches of soil—

	Percent
Low	Less than 2
Moderate	2 to 4
High	4 to 8
Very high	More than 8

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by water that originated mainly from the melting of glacial ice. Glacial outwash is commonly in valleys on landforms known as valley trains, outwash terraces, eskers, kame terraces, kames, outwash fans, or deltas.

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly. The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are *very slow* (less than 0.06 inch), *slow* (0.06 to 0.20 inch), *moderately slow* (0.2 to 0.6 inch), *moderate* (0.6 to 2.0 inches), *moderately rapid* (2.0 to 6.0 inches), *rapid* (6.0 to 20 inches), and *very rapid* (more than 20 inches).

pH value. (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

Piping. Moving water forms subsurface tunnels or pipelike cavities in the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from a semisolid to a plastic state.

Poor outlets. Surface or subsurface drainage outlets difficult or expensive to install.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Range condition. The health or productivity of forage plants on a given range, in terms of the potential productivity under normal climate and the best practical management. Condition classes generally recognized are—*excellent, good, fair,* and *poor.* The classification is based on the percentage of original, or assumed climax vegetation on a site, as compared to what has been observed to grow on it when well managed.

Range site. An area of range where climate, soil, and relief are sufficiently uniform to produce a distinct kind and amount of native vegetation.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow refill. The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones. Rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Small stones adversely affect the specified use.

Soil. A natural, three-dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *very coarse sand* (2.0 millimeters to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use or management.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer. Otherwise suitable soil material too thin for the specified use.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Well graded. Refers to a soil or soil material consisting of particles well distributed over a wide range in size or diameter. Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Illustrations

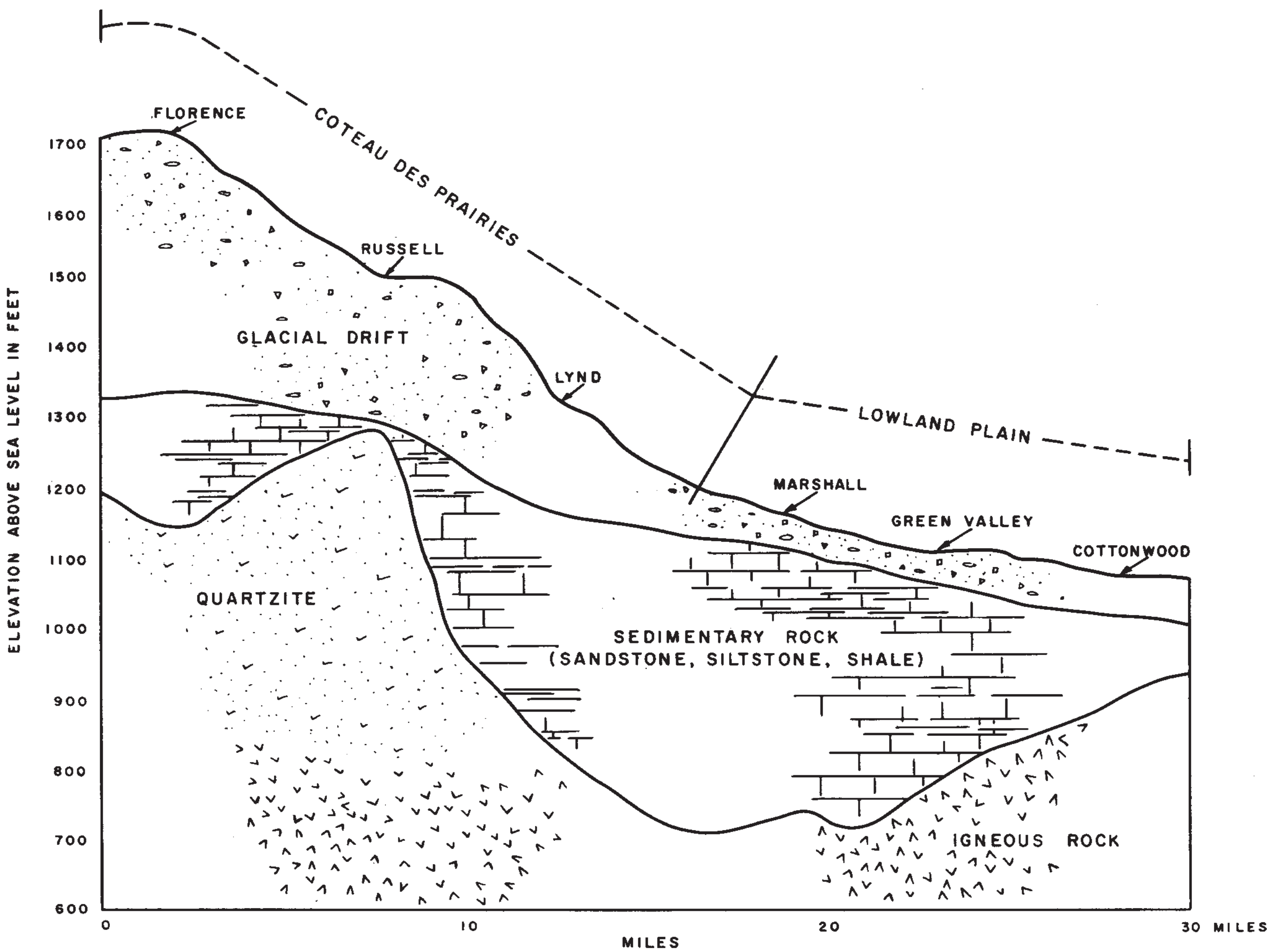

Figure 1.—A southwest-to-northeast cross section of Lyon County showing differences in elevation, thickness of the glacial drift, and the kinds of underlying rock.

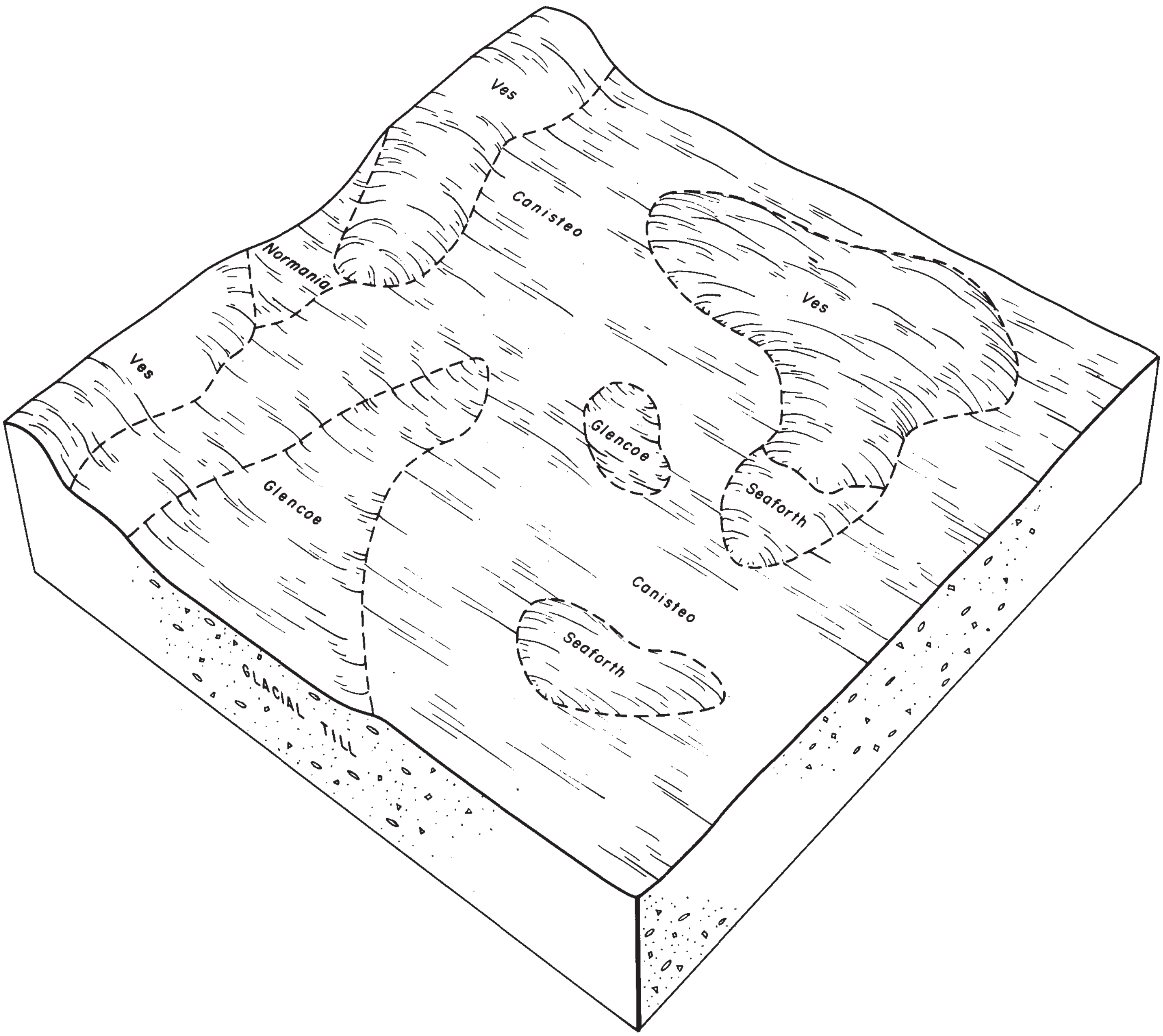

Figure 2.—Pattern of soils and underlying material in the Ves-Canisteo map unit.

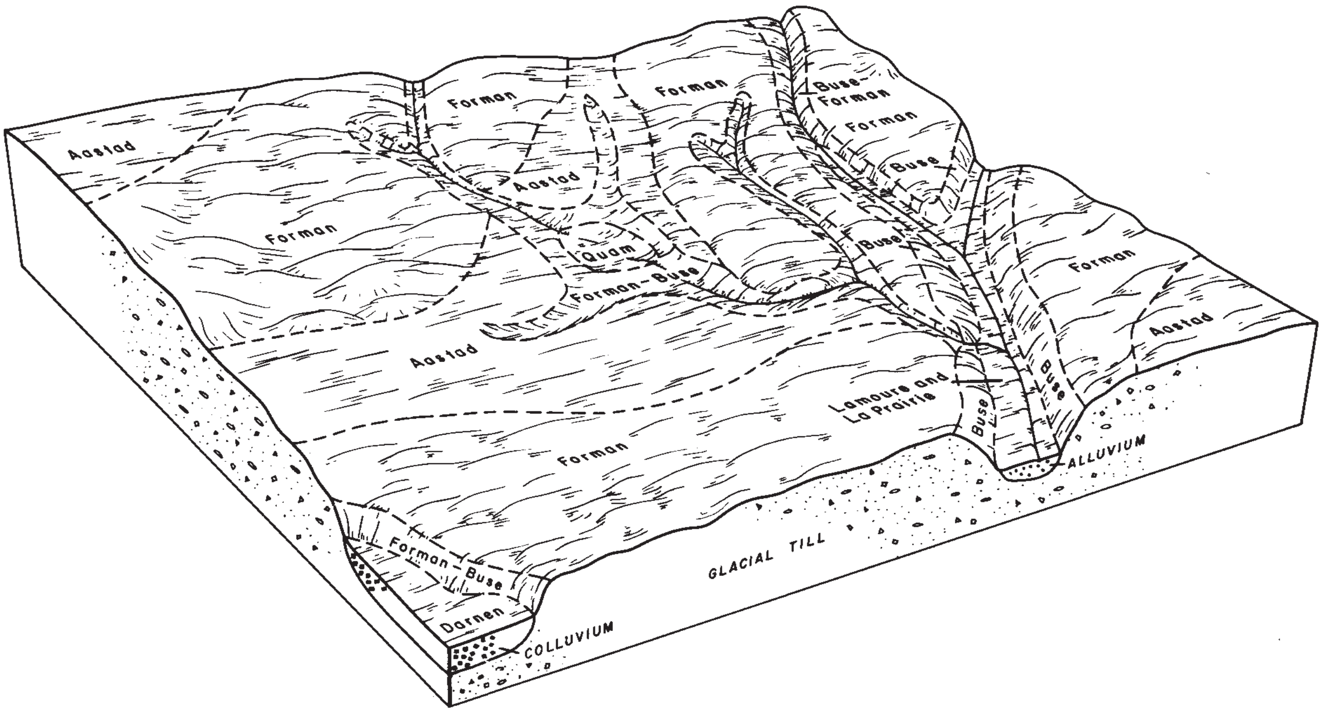

Figure 3.—Pattern of soils and underlying material in the Forman-Aastad map unit.

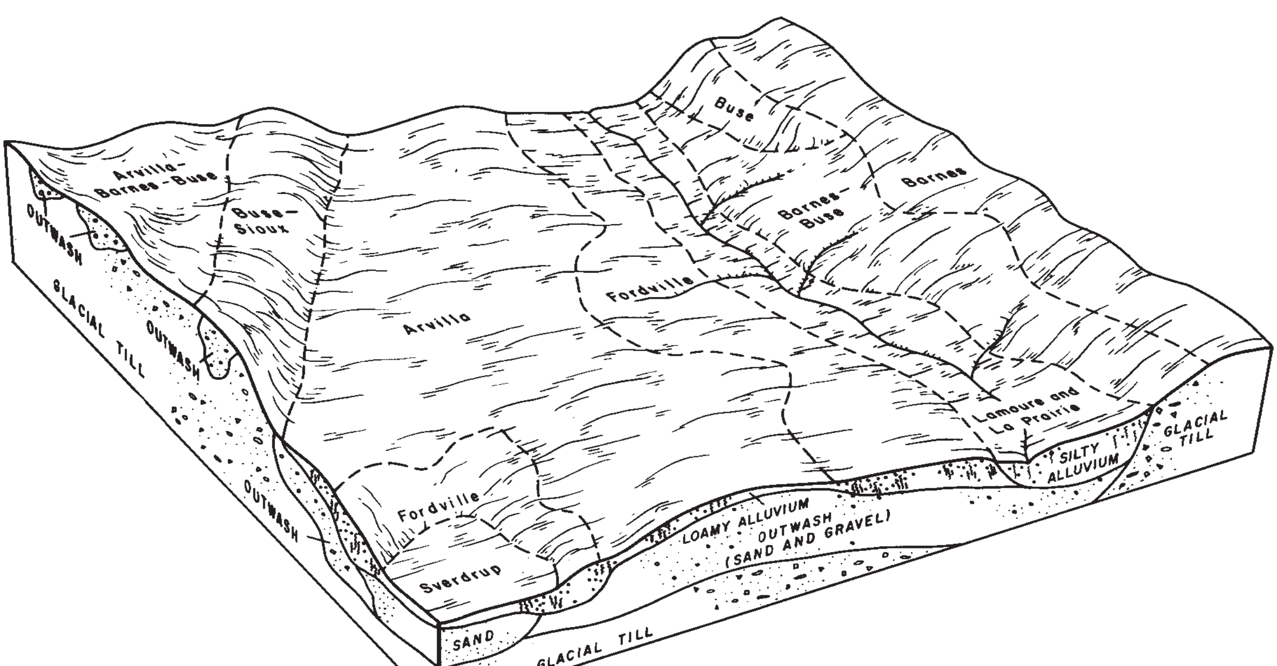

Figure 4.—Pattern of soils and underlying material in the Arvilla-Barnes-Buse map unit.

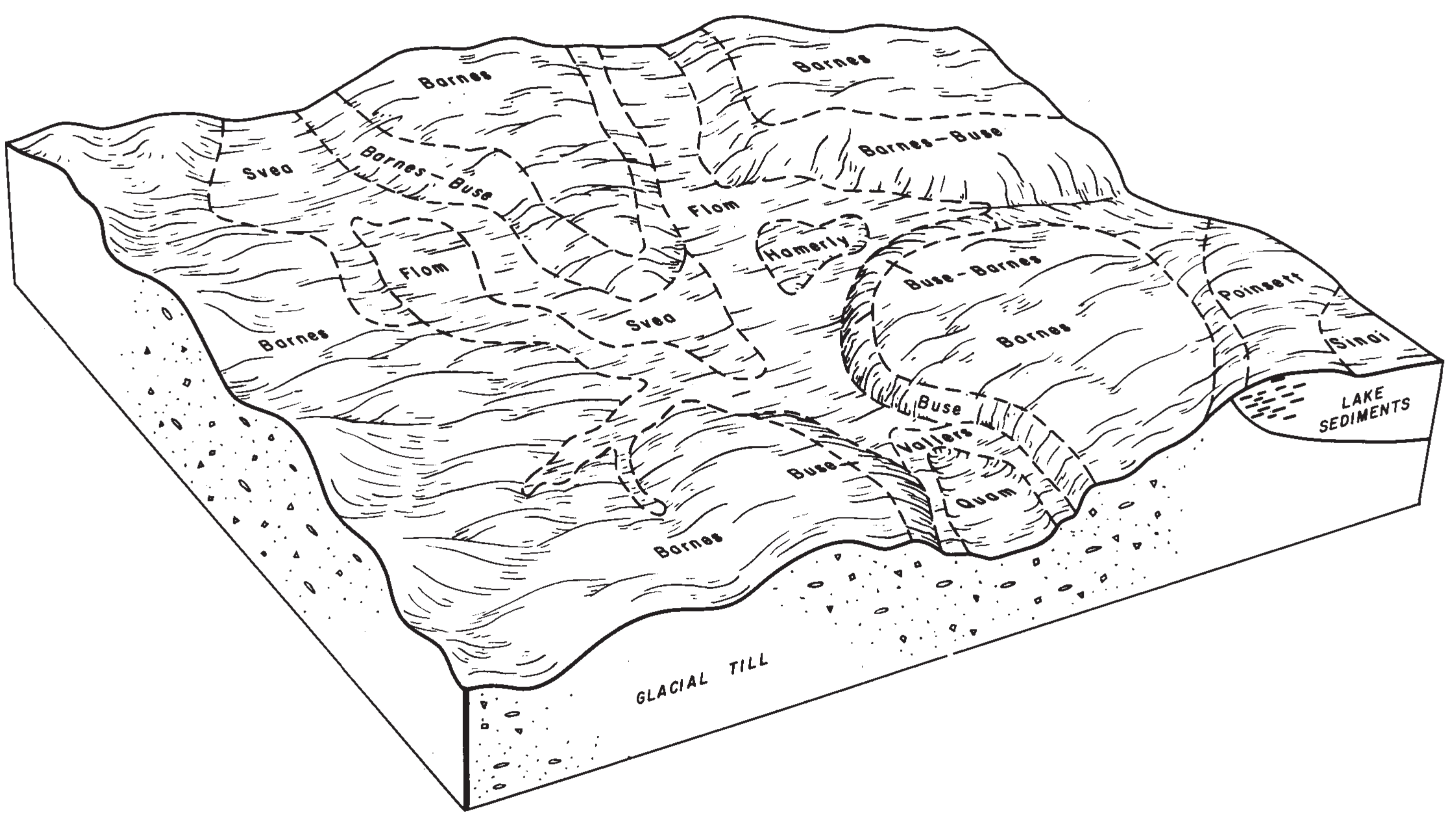

Figure 5.—Pattern of soils and underlying material in the Barnes-Flom-Buse map unit.

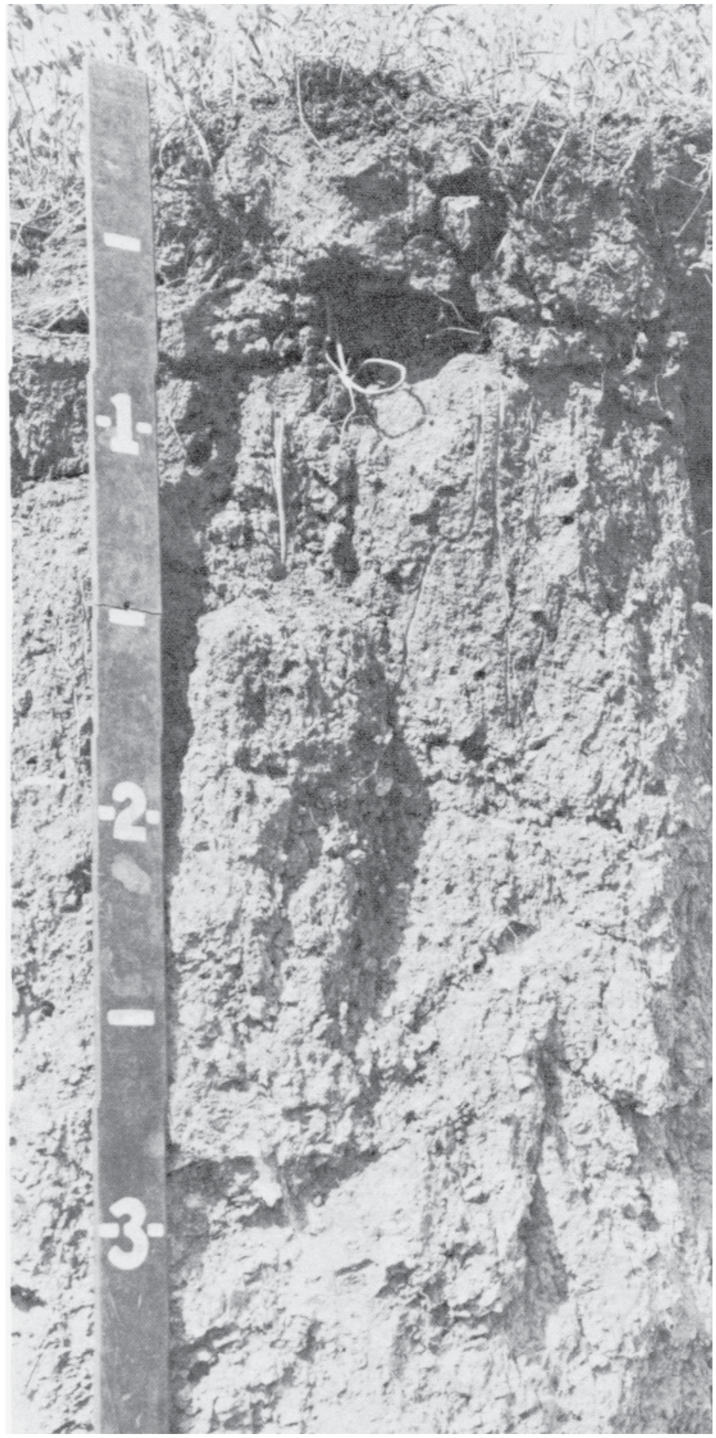

Figure 6.—Profile of Barnes loam, 1 to 4 percent slopes. The dark colored surface layer is about 11 inches thick; the subsoil, about 13 inches thick. The underlying material is light colored, calcareous glacial till.

Figure 7.—Grassed waterway in an area of Flom clay loam.

Figure 8.—An area of Canisteo clay loam, which has a grayish surface layer when dry. The darker areas are a Glencoe soil.

Figure 9.—Profile of Arvilla sandy loam, 0 to 2 percent slopes, in a gravel pit. About 19 inches of sandy loam is underlain by gravelly loamy coarse sand.

Figure 10.—Profile of Buse loam, 18 to 25 percent slopes. The thin surface layer is very dark gray.

Figure 11.—Lamoure and La Prairie soils, frequently flooded, along a stream channel. The recreational facilities are on La Prairie soils that are only occasionally flooded.

Figure 12.—Gravel pit in an area of Arvilla soils. The gravel and the surface soil have been stockpiled.

Figure 13.—Contour stripcropping on Forman-Buse complex, 6 to 12 percent slopes, eroded.

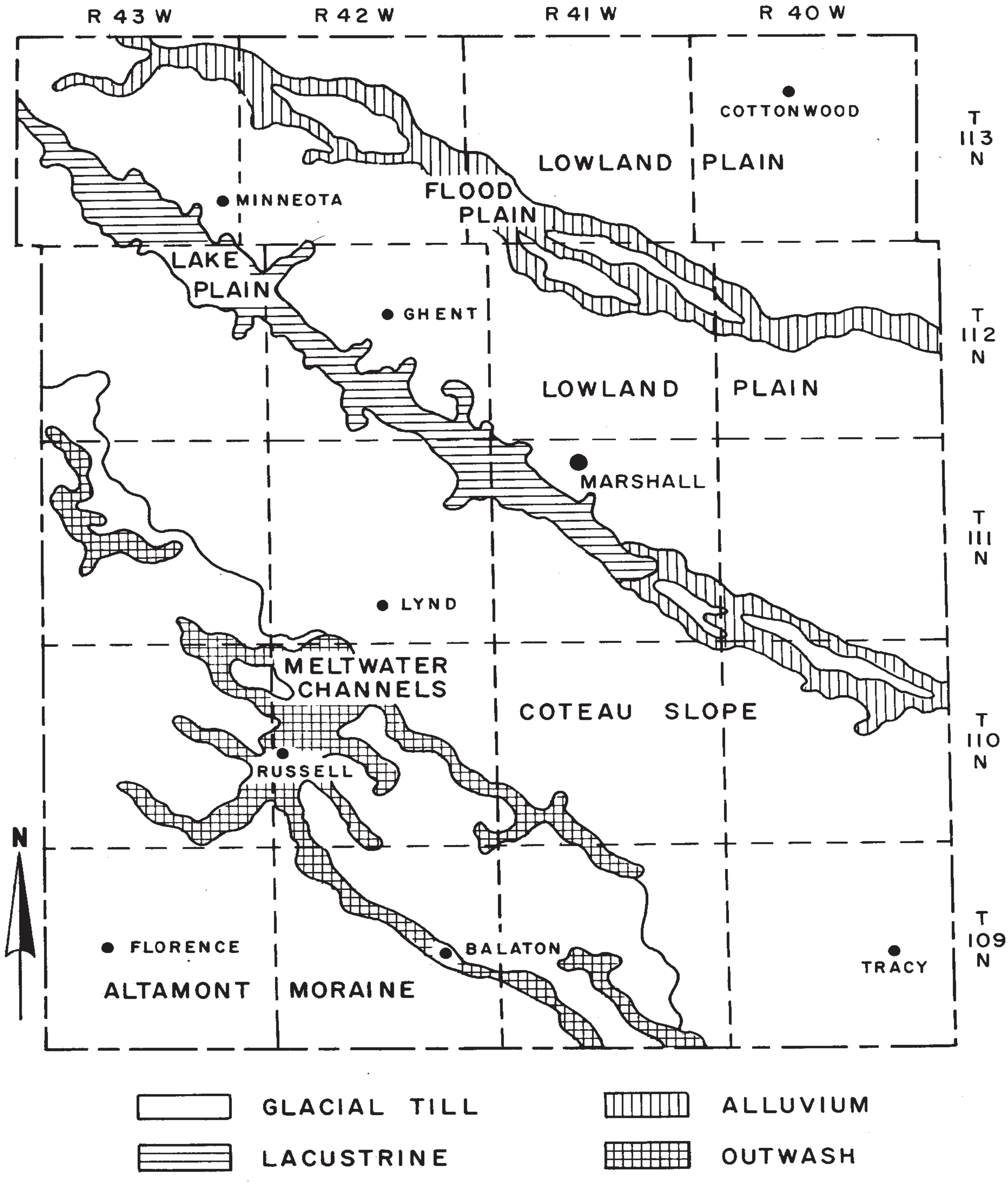

Figure 14.—Parent material and the major geomorphic areas in Lyon County.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION DATA

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average snowfall	Average number of days with 0.10 inch or more
	°F	°F	°F	°F	°F	Units	In	In	In	In	
January----	22.1	3.0	12.6	48	-26	0	.55	.16	.97	9.0	1
February---	24.9	5.3	15.1	53	-20	0	.73	.18	1.21	7.2	2
March------	38.1	19.4	28.8	72	-10	0	1.25	.45	2.10	8.4	3
April------	55.1	34.0	44.6	83	15	56	2.57	1.19	3.63	2.9	5
May--------	69.7	46.6	58.2	94	26	269	3.27	1.71	5.11	0.2	5
June-------	78.1	55.9	67.0	98	38	510	4.11	2.46	5.65	0	7
July-------	85.6	62.5	74.0	103	47	744	3.10	1.61	4.70	0	5
August-----	81.7	58.7	70.2	101	42	626	2.84	1.27	4.40	0	7
September--	73.0	50.4	61.7	97	28	345	2.53	1.37	3.80	0.1	4
October----	60.3	38.3	49.3	87	19	102	1.61	.51	2.63	0.8	3
November---	41.9	24.2	33.0	71	- 5	0	1.00	.22	1.91	3.3	3
December---	27.9	9.5	18.7	53	-18	0	.71	.18	1.10	6.4	2
Year-----	54.9	34.0	44.4	103	-26	2,652	24.33	19.66	29.72	38.3	47

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 30	May 10	May 25
2 years in 10 later than--	April 26	May 3	May 16
5 years in 10 later than--	April 7	April 19	May 7
First freezing temperature in fall:			
1 year in 10 earlier than--	October 10	October 1	September 13
2 years in 10 earlier than--	October 14	October 4	September 24
5 years in 10 earlier than--	October 23	October 9	October 1

TABLE 3.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
6	Aastad clay loam, 0 to 2 percent slopes	15,400	3.4
33B	Barnes loam, 1 to 4 percent slopes	20,650	4.5
33B2	Barnes loam, 3 to 6 percent slopes, eroded	21,050	4.6
36	Flom clay loam	28,000	6.1
51	La Prairie loam	6,100	1.3
70	Svea loam, 1 to 3 percent slopes	3,900	0.9
86	Canisteo clay loam	52,800	11.5
114	Glencoe silty clay loam	14,250	3.1
127	Sverdrup sandy loam, 0 to 2 percent slopes	1,040	0.2
127B	Sverdrup sandy loam, 2 to 6 percent slopes	2,000	0.4
149B	Everly clay loam, 2 to 4 percent slopes	12,600	2.7
149B2	Everly clay loam, 3 to 6 percent slopes, eroded	3,130	0.7
149C2	Everly clay loam, 6 to 12 percent slopes, eroded	1,055	0.2
168B	Forman clay loam, 2 to 4 percent slopes	24,000	5.2
168B2	Forman clay loam, 3 to 6 percent slopes, eroded	15,800	3.4
184	Hamerly loam, 1 to 3 percent slopes	2,350	0.5
210	Fulda silty clay	1,445	0.3
212	Sinai silty clay, 1 to 3 percent slopes	1,715	0.4
219	Rolfe loam	280	0.1
236	Vallers clay loam	6,700	1.5
241	Letri clay loam	8,000	1.7
246	Marysland loam	3,970	0.9
276	Oldham silty clay loam	1,475	0.3
284B	Poinsett silty clay loam, 1 to 4 percent slopes	2,600	0.6
284B2	Poinsett silty clay loam, 3 to 6 percent slopes, eroded	680	0.1
284C2	Poinsett silty clay loam, 6 to 12 percent slopes, eroded	565	0.1
335	Urness silt loam	2,250	0.5
339	Fordville loam, 0 to 2 percent slopes	2,900	0.6
339B	Fordville loam, 2 to 6 percent slopes	1,730	0.4
341	Arvilla sandy loam, 0 to 2 percent slopes	2,050	0.4
341B	Arvilla sandy loam, 2 to 6 percent slopes	3,500	0.8
341C	Arvilla sandy loam, 6 to 12 percent slopes	1,350	0.3
344	Quam silty clay loam	6,120	1.3
345	Wilmonton clay loam, 0 to 2 percent slopes	4,600	1.0
347	Malachy loam	800	0.2
402E	Sioux soils, 2 to 40 percent slopes	290	0.1
418	Lamoure silty clay loam	11,250	2.5
421B	Ves loam, 1 to 4 percent slopes	29,750	6.5
421B2	Ves loam, 3 to 6 percent slopes, eroded	22,779	5.0
423	Seaforth loam, 1 to 3 percent slopes	10,930	2.4
437E	Buse loam, 18 to 25 percent slopes	2,650	0.6
437F	Buse loam, 25 to 40 percent slopes	4,200	0.9
446	Normania loam, 1 to 3 percent slopes	8,900	1.9
450	Rauville silty clay loam	3,500	0.8
494B	Darnen loam, 2 to 6 percent slopes	2,210	0.5
894D2	Storden-Everly complex, 12 to 18 percent slopes, eroded	385	0.1
902C2	Barnes-Buse loams, 6 to 12 percent slopes, eroded	15,700	3.4
904B2	Arvilla-Barnes-Buse complex, 2 to 6 percent slopes, eroded	550	0.1
904C2	Arvilla-Buse-Barnes complex, 6 to 12 percent slopes, eroded	1,650	0.4
913D2	Buse-Barnes loams, 12 to 18 percent slopes, eroded	3,150	0.7
915C2	Forman-Buse complex, 6 to 12 percent slopes, eroded	8,300	1.8
915D2	Buse-Forman complex, 12 to 18 percent slopes, eroded	3,250	0.7
917D2	Buse-Sioux complex, 12 to 18 percent slopes, eroded	330	0.1
917E	Buse-Sioux complex, 18 to 40 percent slopes	390	0.1
953C	Arvilla-Storden-Ves complex, 6 to 15 percent slopes	365	0.1
954C2	Storden-Ves loams, 5 to 12 percent slopes, eroded	7,000	1.5
954D2	Storden-Ves loams, 12 to 18 percent slopes, eroded	425	0.1
986	Lamoure and La Prairie soils, frequently flooded	13,850	3.0
1016	Udorthents	500	0.1
1029	Pits, gravel	790	0.2
1032	Aquents and Udorthents	365	0.1
1053	Aquolls and Aquents, ponded	6,650	1.5
1809	Bearden complex	4,600	1.0
1810	Colvin complex	11,100	2.4
1814	Oldham silty clay	840	0.2
	Water	4,736	1.0
	Total	458,240	100.0

TABLE 4.--YIELDS PER ACRE OF CROPS AND PASTURE

[All yields were estimated for a high level of management in 1976. Absence of a yield figure indicates the crop is seldom grown or is not suited. Only arable soils are listed]

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Bromegrass-alfalfa
	Bu	Bu	Bu	Ton	AUM*
6-------------------------- Aastad	85	32	80	4.2	6.3
33B------------------------ Barnes	75	27	75	3.8	5.7
33B2----------------------- Barnes	65	23	70	3.8	5.7
36------------------------- Flom	80	30	80	4.0	6.0
51------------------------- La Prairie	75	30	80	4.0	6.0
70------------------------- Svea	80	28	80	4.0	6.0
86------------------------- Canisteo	90	33	75	4.0	6.0
114------------------------ Glencoe	85	34	75	3.5	5.2
127------------------------ Sverdrup	40	18	50	2.7	4.0
127B----------------------- Sverdrup	35	15	40	2.5	3.7
149B----------------------- Everly	90	32	80	4.4	6.6
149B2---------------------- Everly	80	28	75	4.0	6.0
149C2---------------------- Everly	70	24	60	3.6	5.4
168B----------------------- Forman	80	30	80	4.0	6.0
168B2---------------------- Forman	70	27	75	3.8	5.7
184------------------------ Hamerly	70	25	75	3.8	5.7
210------------------------ Fulda	80	30	75	4.0	6.0
212------------------------ Sinai	80	28	80	3.8	5.7
219------------------------ Rolfe	85	33	70	3.0	4.5
236------------------------ Vallers	80	30	75	3.8	5.7
241------------------------ Letri	95	35	80	4.0	6.0
246------------------------ Marysland	65	25	70	3.0	4.5

See footnote at end of table.

TABLE 4.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Bromegrass-alfalfa
	Bu	Bu	Bu	Ton	AUM*
276---------------------- Oldham	75	30	70	3.5	5.2
284B--------------------- Poinsett	80	28	80	4.0	6.0
284B2-------------------- Poinsett	70	25	75	3.5	5.2
284C2-------------------- Poinsett	55	20	60	3.0	4.5
335---------------------- Urness	70	30	70	3.5	5.2
339---------------------- Fordville	60	22	65	3.0	4.5
339B--------------------- Fordville	55	19	60	2.6	3.9
341---------------------- Arvilla	35	17	45	2.3	3.5
341B--------------------- Arvilla	30	15	35	1.7	3.4
341C--------------------- Arvilla	20	11	25	1.5	2.0
344---------------------- Quam	80	30	75	3.5	5.2
345---------------------- Wilmonton	95	35	80	4.5	6.7
347---------------------- Malachy	60	24	55	3.5	5.2
418---------------------- Lamoure	80	30	75	3.5	5.2
421B--------------------- Ves	85	32	80	4.3	6.3
421B2-------------------- Ves	75	29	75	4.0	6.0
423---------------------- Seaforth	80	30	75	4.4	6.6
437E--------------------- Buse	---	---	---	1.6	2.2
446---------------------- Normania	90	34	80	4.5	6.7
494B--------------------- Darnen	80	30	80	4.0	6.0
894D2-------------------- Storden-Everly	50	---	45	2.9	4.3
902C2-------------------- Barnes-Buse	55	19	60	3.0	4.5

See footnote at end of table.

TABLE 4.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Bromegrass-alfalfa
	Bu	Bu	Bu	Ton	AUM*
904B2 Arvilla-Barnes-Buse	40	19	50	2.7	4.0
904C2 Arvilla-Buse-Barnes	35	15	45	2.2	3.3
913D2 Buse-Barnes	45	---	50	2.5	3.7
915C2 Forman-Buse	65	22	60	3.0	4.5
915D2 Buse-Forman	55	---	50	2.5	3.7
917D2 Buse-Sioux	25	---	30	1.4	2.0
953C Arvilla-Storden	30	15	40	2.2	3.3
954C2 Storden-Ves	65	23	60	3.4	5.0
954D2 Storden-Ves	45	---	45	2.6	3.9
1809 Bearden	75	30	75	4.0	6.0
1810 Colvin	85	32	75	4.0	6.0
1814 Oldham	75	30	70	3.5	5.2

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for a period of 30 days.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Soils not listed do not support rangeland vegetation suited to grazing]

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
33B, 33B2: Barnes	Silty	Favorable	4,300	Big bluestem	40
		Normal	3,800	Western wheatgrass	5
		Unfavorable	3,200	Needleandthread	10
				Indiangrass	10
				Switchgrass	10
				Little bluestem	5
				Side-oats grama	5
				Porcupinegrass	5
				Blue grama	5
36: Flom	Subirrigated	Favorable	6,400	Big bluestem	40
		Normal	5,800	Indiangrass	20
		Unfavorable	5,200	Switchgrass	10
				Prairie cordgrass	5
				Western wheatgrass	5
				Tall dropseed	5
				Sedge	5
51: La Prairie	Overflow	Favorable	5,500	Big bluestem	45
		Normal	5,000	Indiangrass	10
		Unfavorable	4,500	Switchgrass	10
				Green needlegrass	10
				Porcupinegrass	5
				Sedge	5
127, 127B: Sverdrup	Sandy	Favorable	3,600	Big bluestem	20
		Normal	3,200	Little bluestem	15
		Unfavorable	2,800	Prairie sandreed	10
				Needleandthread	10
				Indiangrass	5
				Switchgrass	5
				Canada wildrye	5
				Porcupinegrass	5
				Western wheatgrass	5
				Side-oats grama	5
				Blue grama	5
168B, 168B2: Forman	Silty	Favorable	4,300	Big bluestem	40
		Normal	3,800	Western wheatgrass	5
		Unfavorable	3,200	Needleandthread	10
				Indiangrass	10
				Switchgrass	10
				Little bluestem	5
				Side-oats grama	5
				Porcupinegrass	5
				Blue grama	5
212: Sinai	Clayey	Favorable	4,320	Needlegrass	25
		Normal	3,600	Western wheatgrass	5
		Unfavorable	2,520	Little bluestem	15
				Big bluestem	30
				Side-oats grama	10
				Blue grama	5
				Sedge	5
236: Vallers	Subirrigated	Favorable	6,400	Big bluestem	40
		Normal	5,800	Indiangrass	15
		Unfavorable	5,200	Switchgrass	10
				Prairie cordgrass	10
				Western wheatgrass	5
				Kentucky bluegrass	5
276: Oldham	Wetland	Favorable	7,000	Prairie cordgrass	85
		Normal	6,500	Sedge	10
		Unfavorable	6,000		

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
284B, 284B2, 284C2-- Poinsett	Silty	Favorable	4,300	Little bluestem	25
		Normal	3,800	Big bluestem	30
		Unfavorable	3,200	Western wheatgrass	5
				Indiangrass	10
				Needleandthread	10
				Side-oats grama	5
				Blue grama	5
				Sedge	5
335-- Urness	Wetland	Favorable	7,500	Prairie cordgrass	25
		Normal	7,000	Northern reedgrass	20
		Unfavorable	6,500	Reed canarygrass	20
				Sedge	20
				Switchgrass	5
339-- Fordville	Silty	Favorable	4,080	Big bluestem	35
		Normal	3,400	Western wheatgrass	5
		Unfavorable	2,380	Green needlegrass	15
				Little bluestem	10
				Needleandthread	10
				Side-oats grama	5
				Blue grama	5
				Sedge	5
339B-- Fordville	Silty	Favorable	3,840	Little bluestem	5
		Normal	3,200	Western wheatgrass	5
		Unfavorable	2,240	Big bluestem	20
				Green needlegrass	15
				Needleandthread	10
				Side-oats grama	5
				Blue grama	5
				Sedge	5
341, 341B, 341C-- Arvilla	Shallow to Gravel	Favorable	2,800	Needleandthread	25
		Normal	2,400	Western wheatgrass	5
		Unfavorable	1,440	Blue grama	10
				Little bluestem	15
				Green needlegrass	5
				Kentucky bluegrass	5
344-- Quam	Wetland	Favorable	7,500	Prairie cordgrass	25
		Normal	7,000	Northern reedgrass	20
		Unfavorable	6,500	Reed canarygrass	20
				Sedge	20
				Switchgrass	5
402E-- Sioux	Very Shallow	Favorable	2,400	Blue grama	25
		Normal	2,000	Needleandthread	30
		Unfavorable	1,200	Side-oats grama	15
				Sedge	15
418-- Lamoure	Subirrigated	Favorable	6,050	Big bluestem	60
		Normal	5,500	Switchgrass	10
		Unfavorable	4,400	Sedge	10
				Indiangrass	5
				Kentucky bluegrass	5
437E, 437F-- Buse	Thin Upland	Favorable	3,200	Little bluestem	20
		Normal	2,800	Side-oats grama	15
		Unfavorable	2,300	Needleandthread	15
				Big bluestem	10
				Indiangrass	10
				Blue grama	10
				Prairie dropseed	5
				Green needlegrass	5
450-- Rauville	Wetland	Favorable	7,200	Prairie cordgrass	85
		Normal	6,600	Sedge	10
		Unfavorable	5,280		

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
494B-----Darnen	Overflow-----	Favorable	5,500	Big bluestem-----	20
		Normal	5,000	Little bluestem-----	10
		Unfavorable	4,500	Indiangrass-----	10
				Western wheatgrass-----	10
				Needleandthread-----	10
				Blue grama-----	10
				Side-oats grama-----	10
				Switchgrass-----	5
				Tall dropseed-----	5
902C2*:					
Barnes-----	Silty-----	Favorable	3,800	Big bluestem-----	30
		Normal	3,300	Western wheatgrass-----	5
		Unfavorable	2,800	Needleandthread-----	10
				Indiangrass-----	10
				Switchgrass-----	10
				Little bluestem-----	10
				Side-oats grama-----	10
				Porcupinegrass-----	5
				Blue grama-----	5
Buse-----	Thin Upland-----	Favorable	3,500	Little bluestem-----	20
		Normal	3,000	Side-oats grama-----	15
		Unfavorable	2,500	Needleandthread-----	15
				Big bluestem-----	10
				Indiangrass-----	10
				Blue grama-----	10
				Prairie dropseed-----	5
				Green needlegrass-----	5
904B2*:					
Arvilla-----	Shallow to Gravel-----	Favorable	2,800	Needleandthread-----	25
		Normal	2,400	Western wheatgrass-----	5
		Unfavorable	1,440	Blue grama-----	10
				Little bluestem-----	15
				Green needlegrass-----	5
				Kentucky bluegrass-----	5
Barnes-----	Silty-----	Favorable	4,300	Big bluestem-----	40
		Normal	3,800	Western wheatgrass-----	5
		Unfavorable	3,200	Needleandthread-----	10
				Indiangrass-----	10
				Switchgrass-----	10
				Little bluestem-----	5
				Side-oats grama-----	5
				Porcupinegrass-----	5
				Blue grama-----	5
Buse-----	Thin Upland-----	Favorable	3,800	Little bluestem-----	20
		Normal	3,200	Side-oats grama-----	15
		Unfavorable	2,800	Needleandthread-----	15
				Big bluestem-----	10
				Indiangrass-----	10
				Blue grama-----	10
				Prairie dropseed-----	5
				Green needlegrass-----	5
904C2*:					
Arvilla-----	Shallow to Gravel-----	Favorable	2,800	Needleandthread-----	25
		Normal	2,400	Western wheatgrass-----	5
		Unfavorable	1,440	Blue grama-----	10
				Little bluestem-----	15
				Green needlegrass-----	5
				Kentucky bluegrass-----	5

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Compo- sition
		Kind of year	Dry weight		
			Lb/acre		Pct
904C2*:					
Buse	Thin Upland	Favorable	3,500	Little bluestem	20
		Normal	3,000	Side-oats grama	15
		Unfavorable	2,500	Needleandthread	15
				Big bluestem	10
				Indiangrass	10
				Blue grama	10
				Prairie dropseed	5
				Green needlegrass	5
Barnes	Silty	Favorable	3,800	Big bluestem	30
		Normal	3,300	Western wheatgrass	5
		Unfavorable	2,800	Needleandthread	10
				Indiangrass	10
				Switchgrass	10
				Little bluestem	5
				Side-oats grama	5
				Porcupinegrass	5
				Blue grama	5
913D2*:					
Buse	Thin Upland	Favorable	3,500	Little bluestem	20
		Normal	3,000	Side-oats grama	15
		Unfavorable	2,500	Needleandthread	15
				Big bluestem	10
				Indiangrass	10
				Blue grama	10
				Prairie dropseed	5
				Green needlegrass	5
Barnes	Silty	Favorable	3,600	Big bluestem	20
		Normal	3,200	Western wheatgrass	5
		Unfavorable	2,800	Needleandthread	15
				Indiangrass	10
				Switchgrass	10
				Little bluestem	5
				Side-oats grama	10
				Porcupinegrass	5
				Blue grama	5
915C2*:					
Forman	Silty	Favorable	3,800	Big bluestem	20
		Normal	3,300	Western wheatgrass	5
		Unfavorable	2,800	Needleandthread	15
				Indiangrass	10
				Switchgrass	10
				Little bluestem	5
				Side-oats grama	5
				Porcupinegrass	5
				Blue grama	5
Buse	Thin Upland	Favorable	3,500	Little bluestem	20
		Normal	3,000	Side-oats grama	15
		Unfavorable	2,500	Needleandthread	15
				Big bluestem	10
				Indiangrass	10
				Blue grama	10
				Prairie dropseed	5
				Green needlegrass	5
915D2*:					
Buse	Thin Upland	Favorable	3,500	Little bluestem	20
		Normal	3,000	Side-oats grama	15
		Unfavorable	2,500	Needleandthread	15
				Big bluestem	10
				Indiangrass	10
				Blue grama	10
				Prairie dropseed	5
				Green needlegrass	5

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
915D2*:					
Forman	Silty	Favorable	3,600	Big bluestem	20
		Normal	3,200	Western wheatgrass	5
		Unfavorable	2,800	Needleandthread	15
				Switchgrass	10
				Indiangrass	10
				Little bluestem	5
				Side-oats grama	5
				Porcupinegrass	5
				Blue grama	5
917D2*:					
Buse	Thin Upland	Favorable	3,500	Little bluestem	20
		Normal	3,000	Side-oats grama	15
		Unfavorable	2,500	Needleandthread	15
				Big bluestem	10
				Indiangrass	10
				Blue grama	10
				Prairie dropseed	5
				Green needlegrass	5
Sioux	Very Shallow	Favorable	2,400	Blue grama	25
		Normal	2,000	Needleandthread	30
		Unfavorable	1,200	Side-oats grama	15
				Sedge	15
917E*:					
Buse	Thin Upland	Favorable	3,200	Little bluestem	20
		Normal	2,800	Side-oats grama	15
		Unfavorable	2,300	Needleandthread	15
				Big bluestem	10
				Indiangrass	10
				Blue grama	10
				Prairie dropseed	5
				Green needlegrass	5
Sioux	Very Shallow	Favorable	2,400	Blue grama	25
		Normal	2,000	Needleandthread	30
		Unfavorable	1,200	Side-oats grama	15
				Sedge	15
986*:					
Lamoure	Subirrigated	Favorable	6,050	Big bluestem	60
		Normal	5,500	Switchgrass	10
		Unfavorable	4,400	Sedge	10
				Indiangrass	5
				Kentucky bluegrass	5
La Prairie	Overflow	Favorable	---		
		Normal	---		
		Unfavorable	---		

*See map unit description for the composition and behavior of the map unit.

TABLE 6.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; the symbol > means greater than. Only soils suited to windbreaks are listed. Absence of an entry means that trees of the height class do not normally grow on this soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--			
	8-15	16-25	26-35	>35
6----------------- Aastad	Tatarian honeysuckle, lilac, Siberian peashrub.	Northern white-cedar, Black Hills spruce, Siberian crabapple, Amur maple.	Scotch pine, green ash, ponderosa pine.	Eastern cottonwood, silver maple.
33B, 33B2--------- Barnes	Siberian peashrub, Tatarian honeysuckle, lilac.	Eastern redcedar, blue spruce, Black Hills spruce.	Green ash, Scotch pine, ponderosa pine, Russian-olive.	Eastern cottonwood, silver maple.
36---------------- Flom	Northern white-cedar, lilac, tall purple willow, Tatarian honeysuckle.	Ponderosa pine, blue spruce, Amur maple, Russian-olive.	Golden willow, green ash, common hackberry.	Eastern cottonwood.
51---------------- La Prairie	Siberian peashrub, Tatarian honeysuckle, American plum.	Blue spruce, eastern redcedar, Black Hills spruce.	Green ash, ponderosa pine, Russian-olive.	Eastern cottonwood, silver maple, Siberian elm.
70---------------- Svea	Siberian peashrub, Tatarian honeysuckle, American plum.	Black Hills spruce, common chokecherry, eastern redcedar, northern white-cedar.	Green ash, ponderosa pine, eastern white pine.	Eastern cottonwood, silver maple.
86---------------- Canisteo	Tall purple willow, redosier dogwood, Tatarian honeysuckle, Siberian peashrub.	Russian-olive, eastern redcedar, northern white-cedar.	Green ash-------------	Eastern cottonwood, golden willow, Siberian elm.
114--------------- Glencoe	Northern white-cedar, lilac, tall purple willow, Tatarian honeysuckle.	Ponderosa pine, blue spruce, Amur maple, Russian-olive.	Golden willow, green ash, common hackberry.	Eastern cottonwood.
127, 127B--------- Sverdrup	Eastern redcedar, Russian-olive, Tatarian honeysuckle, Siberian peashrub, American plum.	Eastern white pine, red pine, common hackberry, bur oak, ponderosa pine, green ash.	---	---
149B, 149B2, 149C2------------ Everly	Redosier dogwood, Tatarian honeysuckle, lilac.	Eastern redcedar, Amur maple, Siberian crabapple.	Ponderosa pine, Norway spruce, common hackberry, green ash.	Silver maple, eastern cottonwood.
168B, 168B2------- Forman	Siberian peashrub, Tatarian honeysuckle, lilac.	Eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce.	Green ash, ponderosa pine, Scotch pine, Russian-olive.	Silver maple, eastern cottonwood.
184--------------- Hamerly	American plum, common chokecherry, Siberian peashrub.	Eastern redcedar, ponderosa pine, Black Hills spruce, blue spruce.	American elm, green ash, Russian-olive.	Eastern cottonwood, Siberian elm.
210--------------- Fulda	Northern white-cedar, Tatarian honeysuckle, tall purple willow.	Black Hills spruce, Amur maple, Russian-olive.	Green ash, golden willow.	Eastern cottonwood.
212--------------- Sinai	American plum, silver buffaloberry, Siberian peashrub, lilac, Tatarian honeysuckle.	Eastern redcedar, Siberian crabapple, Black Hills spruce.	Green ash, ponderosa pine, Scotch pine, Russian-olive.	Eastern cottonwood, silver maple.

TABLE 6.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- 8-15	16-25	26-35	>35
219 Rolfe	Zabel honeysuckle, Tatarian honeysuckle, redosier dogwood, Siberian dogwood.	Laurel willow, Amur maple, northern white-cedar.	Green ash	Silver maple, eastern cottonwood.
236 Vallers	Tall purple willow, redosier dogwood, Tatarian honeysuckle, Siberian peashrub.	Russian-olive, eastern redcedar, northern white-cedar.	Green ash	Eastern cottonwood, golden willow, Siberian elm.
241 Letri	Eastern redcedar, lilac, Amur honeysuckle, northern white-cedar.	Black Hills spruce, eastern white pine, Amur maple.	Laurel willow, green ash, silver maple.	Siberian elm, eastern cottonwood.
246 Marysland	Tatarian honeysuckle, Siberian peashrub.	Russian-olive	Green ash	Eastern cottonwood, golden willow, Siberian elm.
276 Oldham	Tall purple willow, Siberian peashrub, Tatarian honeysuckle.	Blue spruce, ponderosa pine, Siberian crabapple.	Golden willow, green ash, common hackberry.	Eastern cottonwood.
284B, 284B2, 284C2 Poinsett	Siberian peashrub, American plum, silver buffaloberry, lilac, Tatarian honeysuckle.	Siberian crabapple, eastern redcedar, Black Hills spruce.	Green ash, ponderosa pine, Scotch pine, Russian-olive.	Eastern cottonwood, silver maple.
335 Urness	Tall purple willow, Tatarian honeysuckle, Siberian peashrub.	Russian-olive, eastern redcedar, northern white-cedar.	Green ash	Eastern cottonwood, golden willow, Siberian elm.
339, 339B Fordville	Siberian crabapple, Tatarian honeysuckle, Siberian peashrub.	Ponderosa pine, Russian-olive, eastern redcedar.	Green ash, common hackberry.	---
341, 341B, 341C Arvilla	Russian-olive, eastern redcedar.	Green ash, ponderosa pine, jack pine, common hackberry.	---	---
344 Quam	Northern white-cedar, lilac, Tatarian honeysuckle.	Russian-olive, white spruce, blue spruce, Amur maple.	Green ash, common hackberry, golden willow.	Eastern cottonwood.
345 Wilmonton	Tatarian honeysuckle, lilac, Siberian peashrub.	Northern white-cedar, Black Hills spruce, Siberian crabapple, Amur maple.	Scotch pine, green ash, common hackberry.	Eastern cottonwood, silver maple.
347 Malachy	Silver buffaloberry, Tatarian honeysuckle, Siberian crabapple, Siberian peashrub.	Eastern redcedar, blue spruce, Siberian crabapple, ponderosa pine, Russian-olive.	Green ash, common hackberry.	Eastern cottonwood.
418 Lamoure	Siberian peashrub, Tatarian honeysuckle, tall purple willow.	Eastern redcedar, blue spruce, ponderosa pine, Siberian crabapple.	Green ash, common hackberry.	Eastern cottonwood, golden willow.
421B, 421B2 Ves	Tatarian honeysuckle, lilac, redosier dogwood.	Eastern redcedar, northern white-cedar, Black Hills spruce, Amur maple, Siberian crabapple.	Scotch pine, green ash, common hackberry, bur oak.	Silver maple, eastern cottonwood.

TABLE 6.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--			
	8-15	16-25	26-35	>35
423-------------- Seaforth	Northern white-cedar, Tatarian honeysuckle, lilac, Siberian peashrub.	Eastern redcedar, blue spruce, ponderosa pine.	Laurel willow, green ash, Russian-olive.	Eastern cottonwood, Siberian elm.
446-------------- Normania	Tatarian honeysuckle, lilac, Siberian peashrub.	Eastern redcedar, northern white-cedar, Black Hills spruce, Amur maple, Siberian crabapple.	Scotch pine, green ash, bur oak, common hackberry.	Eastern cottonwood, silver maple.
494B------------- Darnen	Lilac, Siberian peashrub, Tatarian honeysuckle.	Northern white-cedar, Amur maple, blue spruce, Siberian crabapple.	Eastern white pine, common hackberry, green ash, bur oak, ponderosa pine.	Silver maple, eastern cottonwood.
902C2*:				
Barnes-----------	Siberian peashrub, Tatarian honeysuckle, lilac.	Eastern redcedar, blue spurce, Black Hills spruce.	Green ash, Scotch pine, ponderosa pine, Russian-olive.	Eastern cottonwood, silver maple.
Buse-------------	Northern white-cedar, lilac, Siberian peashrub, Tatarian honeysuckle.	White spruce, ponderosa pine, Siberian crabapple.	Green ash, Russian-olive, common hackberry.	Siberian elm.
904B2*:				
Arvilla----------	Russian-olive, eastern redcedar.	Green ash, ponderosa pine, jack pine, common hackberry.	---	---
Barnes-----------	Siberian peashrub, Tatarian honeysuckle, lilac.	Eastern redcedar, blue spruce, Black Hills spruce.	Green ash, Scotch pine, ponderosa pine, Russian-olive.	Eastern cottonwood, silver maple.
Buse-------------	Northern white-cedar, lilac, Siberian peashrub, Tatarian honeysuckle.	White spruce, ponderosa pine, Siberian crabapple.	Green ash, Russian-olive, common hackberry.	Siberian elm.
904C2*:				
Arvilla----------	Russian-olive, eastern redcedar.	Green ash, ponderosa pine, jack pine, common hackberry.	---	---
Buse-------------	Northern white-cedar, lilac, Siberian peashrub, Tatarian honeysuckle.	White spruce, ponderosa pine, Siberian crabapple.	Green ash, Russian-olive, common hackberry.	Siberian elm.
Barnes-----------	Siberian peashrub, Tatarian honeysuckle, lilac.	Eastern redcedar, blue spruce, Black Hills spruce.	Green ash, Scotch pine, ponderosa pine, Russian-olive.	Eastern cottonwood, silver maple.
915C2*:				
Forman-----------	Siberian peashrub, Tatarian honeysuckle, lilac.	Eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce.	Green ash, ponderosa pine, Scotch pine, Russian-olive.	Silver maple, eastern cottonwood.
Buse-------------	Northern white-cedar, lilac, Siberian peashrub, Tatarian honeysuckle.	White spruce, ponderosa pine, Siberian crabapple.	Green ash, Russian-olive, common hackberry.	Siberian elm.

See footnote at end of table.

TABLE 6.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--			
	8-15	16-25	26-35	>35
953C*:				
Arvilla	Russian-olive, eastern redcedar.	Green ash, ponderosa pine, jack pine, common hackberry.	---	---
Storden	Tall purple willow, Tatarian honeysuckle, Siberian peashrub, northern white-cedar.	Eastern redcedar, white spruce.	Green ash, Russian-olive, golden willow.	Eastern cottonwood, Siberian elm.
Ves	Tatarian honeysuckle, lilac, redosier dogwood.	Eastern redcedar, northern white-cedar, Black Hills spruce, Amur maple, Siberian crabapple.	Scotch pine, green ash, common hackberry, bur oak.	Silver maple, eastern cottonwood.
954C2*:				
Storden	Tall purple willow, Tatarian honeysuckle, Siberian peashrub, northern white-cedar.	Eastern redcedar, white spruce.	Green ash, Russian-olive, golden willow.	Eastern cottonwood, Siberian elm.
Ves	Tatarian honeysuckle, lilac, redosier dogwood.	Eastern redcedar, northern white-cedar, Black Hills spruce, Amur maple, Siberian crabapple.	Scotch pine, green ash, common hackberry, bur oak.	Silver maple, eastern cottonwood.
1809*. Bearden	Eastern redcedar, common chokecherry, Siberian peashrub, Tatarian honeysuckle, American plum.	Ponderosa pine, Black Hills spruce.	Siberian elm, green ash.	Eastern cottonwood.
1810*. Colvin	Tatarian honeysuckle, Siberian peashrub, American plum, eastern redcedar, common chokecherry, Russian-olive.	Blue spruce	Siberian elm, green ash.	Eastern cottonwood.
1814. Oldham	Northern white-cedar, Tatarian honeysuckle, tall purple willow.	Black Hills spruce, Amur maple, Russian-olive.	Golden willow, green ash.	Eastern cottonwood.

* See map unit description for the composition and behavior of the map unit.

TABLE 7.--BUILDING SITE DEVELOPMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
6----------------- Aastad	Moderate: wetness.	Moderate: shrink-swell, low strength.	Moderate: wetness, shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.
33B--------------- Barnes	Slight-----------	Slight-----------	Slight-----------	Slight------------	Moderate: frost action, low strength.
33B2-------------- Barnes	Slight-----------	Slight-----------	Slight-----------	Moderate: slope.	Moderate: frost action, low strength.
36----------------- Flom	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: low strength, frost action.
51----------------- La Prairie	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, low strength.
70----------------- Svea	Moderate: wetness.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell, low strength.	Severe: low strength.
86----------------- Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.
114---------------- Glencoe	Severe: wetness, floods.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.	Severe: wetness, floods, low strength.
127---------------- Sverdrup	Severe: cutbanks cave.	Slight-----------	Slight-----------	Slight------------	Slight.
127B--------------- Sverdrup	Severe: cutbanks cave.	Slight-----------	Slight-----------	Moderate: slope.	Slight.
149B--------------- Everly	Slight-----------	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Severe: low strength.
149B2-------------- Everly	Slight-----------	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, slope, shrink-swell.	Severe: low strength.
149C2-------------- Everly	Moderate: slope.	Moderate: low strength, slope, shrink-swell.	Moderate: low strength, slope, shrink-swell.	Severe: slope.	Severe: low strength.
168B--------------- Forman	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: frost action, shrink-swell, low strength.
168B2-------------- Forman	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: frost action, shrink-swell, low strength.

TABLE 7.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
184 Hamerly	Moderate: wetness.	Moderate: shrink-swell, low strength.	Severe: wetness.	Moderate: shrink-swell, low strength.	Severe: frost action, low strength.
210 Fulda	Severe: wetness.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: low strength, frost action.
212 Sinai	Moderate: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
219 Rolfe	Severe: wetness, floods.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, low strength, floods.
236 Vallers	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: frost action, low strength.
241 Letri	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, frost action, low strength.
246 Marysland	Severe: wetness, floods, cutbanks cave.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods, low strength.
276 Oldham	Severe: wetness, floods.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, low strength.
284B, 284B2, 284C2 Poinsett	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: frost action, low strength.
335 Urness	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness, low strength.
339 Fordville	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
339B Fordville	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
341 Arvilla	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
341B Arvilla	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
341C Arvilla	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
344 Quam	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.

TABLE 7.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
345----------------- Wilmonton	Moderate: wetness.	Moderate: shrink-swell, low strength.	Moderate: wetness, shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength, frost action.
347----------------- Malachy	Severe: cutbanks cave.	Slight-----------	Moderate: wetness.	Slight------------	Severe: frost action.
402E---------------- Sioux	Severe: slope, cutbanks cave.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
418----------------- Lamoure	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, low strength.
421B---------------- Ves	Slight-----------	Slight-----------	Slight-----------	Slight------------	Moderate: frost action, low strength.
421B2--------------- Ves	Slight-----------	Slight-----------	Slight-----------	Moderate: slope.	Moderate: frost action, low strength.
423----------------- Seaforth	Moderate: wetness.	Slight-----------	Moderate: wetness.	Slight------------	Severe: frost action.
437E, 437F---------- Buse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
446----------------- Normania	Moderate: wetness.	Moderate: shrink-swell, low strength.	Moderate: wetness, shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: frost action, low strength.
450----------------- Rauville	Severe: floods, wetness.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.	Severe: low strength, wetness, floods.
494B---------------- Darnen	Slight-----------	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
894D2*:					
Storden-------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Everly--------------	Moderate: slope.	Moderate: low strength, slope, shrink-swell.	Moderate: low strength, slope, shrink-swell.	Severe: slope.	Severe: low strength.
902C2*:					
Barnes--------------	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: frost action, slope, low strength.
Buse----------------	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, slope.	Severe: slope.	Moderate: low strength, frost action, slope.

See footnote at end of table.

TABLE 7.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
904B2*:					
Arvilla----------	Severe: cutbanks cave.	Slight-----------	Slight-----------	Moderate: slope.	Slight.
Barnes-----------	Slight-----------	Slight-----------	Slight-----------	Moderate: slope.	Moderate: frost action, low strength.
Buse-------------	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, frost action.
904C2*:					
Arvilla----------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Buse-------------	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, slope.	Severe: slope.	Moderate: low strength, frost action, slope.
Barnes-----------	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: frost action, slope, low strength.
913D2*:					
Buse-------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Barnes-----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
915C2*:					
Forman-----------	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, slope.	Severe: slope.	Moderate: frost action, shrink-swell, low strength.
Buse-------------	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, slope.	Severe: slope.	Moderate: low strength, frost action, shrink-swell.
915D2*:					
Buse-------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Forman-----------	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, slope.	Severe: slope.	Moderate: frost action, shrink-swell, low strength.
917D2*, 917E*:					
Buse-------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Sioux------------	Severe: slope, cutbanks cave.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
953C*:					
Arvilla----------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.

See footnote at end of table.

TABLE 7.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
953C*:					
Storden----------	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action, low strength.
Ves--------------	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: frost action, slope, low strength.
954C2*:					
Storden----------	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action, low strength.
Ves--------------	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: frost action, slope, low strength.
954D2*:					
Storden----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Ves--------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
986*:					
Lamoure----------	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, low strength.
La Prairie-------	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods, low strength.
1016*. Udorthents					
1029*. Pits, gravel					
1032*. Aquents and Udorthents					
1053*. Aquolls and Aquents					
1809*------------ Bearden	Moderate: wetness.	Moderate: wetness, shrink-swell, low strength.	Severe: wetness.	Moderate: shrink-swell, low strength.	Severe: frost action, low strength.
1810*------------ Colvin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.
1814------------- Oldham	Severe: wetness, floods.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: frost action, floods, low strength.

* See map unit description for the composition and behavior of the map unit.

TABLE 8.--SANITARY FACILITIES

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms used to rate soils. Absence of an entry means soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
6------------------ Aastad	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey.
33B, 33B2----------- Barnes	Moderate: percs slowly.	Moderate: slope, seepage.	Slight-----------	Slight-----------	Good.
36------------------ Flom	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
51------------------ La Prairie	Severe: floods.	Moderate: seepage.	Severe: floods, wetness.	Severe: floods.	Good.
70------------------ Svea	Moderate: percs slowly.	Moderate: slope, seepage, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
86------------------ Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
114----------------- Glencoe	Severe: wetness, floods, percs slowly.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
127, 127B----------- Sverdrup	Slight-----------	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
149B, 149B2--------- Everly	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
149C2--------------- Everly	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
168B, 168B2--------- Forman	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
184----------------- Hamerly	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Good.
210----------------- Fulda	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, wetness.
212----------------- Sinai	Severe: percs slowly.	Slight-----------	Severe: too clayey.	Slight-----------	Poor: too clayey.
219----------------- Rolfe	Severe: floods, percs slowly, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
236----------------- Vallers	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.

TABLE 8.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
241 Letri	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
246 Marysland	Severe: wetness, floods.	Severe: wetness, seepage.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, floods.	Poor: wetness, too sandy.
276 Oldham	Severe: percs slowly, floods, wetness.	Severe: floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
284B, 284B2 Poinsett	Moderate: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
284C2 Poinsett	Moderate: percs slowly, slope.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
335 Urness	Severe: floods, wetness, percs slowly.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
339, 339B Fordville	Slight*	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: small stones, too sandy.
341, 341B Arvilla	Slight*	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
341C Arvilla	Moderate*: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
344 Quam	Severe: floods, wetness, percs slowly.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
345 Wilmonton	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey.
347 Malachy	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: too sandy.
402E Sioux	Severe*: slope.	Severe: slope, seepage.	Severe: seepage, too sandy.	Severe: slope, seepage.	Poor: slope, small stones, seepage.
418 Lamoure	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
421B, 421B2 Ves	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
423 Seaforth	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Good.
437E Buse	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.

See footnotes at end of table.

TABLE 8.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
437F: Buse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
446: Normania	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Good.
450: Rauville	Severe: floods, wetness, percs slowly.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Poor: wetness.
494B: Darnen	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
894D2**:					
Storden	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
Everly	Severe: slope, percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
902C2**:					
Barnes	Moderate: percs slowly, slope.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
Buse	Moderate: percs slowly, slope.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
904B2**:					
Arvilla	Slight*	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
Barnes	Moderate: percs slowly.	Moderate: slope, seepage.	Slight	Slight	Good.
Buse	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
904C2**:					
Arvilla	Moderate*: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
Buse	Moderate: percs slowly, slope.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
Barnes	Moderate: percs slowly, slope.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
913D2**:					
Buse	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
Barnes	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.

See footnotes at end of table.

TABLE 8.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
915C2**:					
Forman	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
Buse	Severe: percs slowly.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
915D2**:					
Buse	Severe: slope, percs slowly.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
Forman	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
917D2**:					
Buse	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
Sioux	Severe*: slope.	Severe: slope, seepage.	Severe: seepage, too sandy.	Severe: slope, seepage.	Poor: slope, small stones, seepage.
917E**:					
Buse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Sioux	Severe*: slope.	Severe: slope, seepage.	Severe: slope, seepage, too sandy.	Severe: slope, seepage.	Poor: slope, small stones, seepage.
953C**:					
Arvilla	Moderate*: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
Storden	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
Ves	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
954C2**:					
Storden	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
Ves	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.	Fair: slope.
954D2**:					
Storden	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
Ves	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
986**:					
Lamoure	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
La Prairie	Severe: wetness.	Moderate: wetness.	Severe: floods, wetness.	Severe: floods.	Good.

See footnotes at end of table.

TABLE 8.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1016**. Udorthents					
1029**. Pits, gravel					
1032**. Aquents and Udorthents					
1053**. Aquolls and Aquents					
1809**. Bearden	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey.
1810**. Colvin	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
1814. Oldham	Severe: percs slowly, floods, wetness.	Severe: floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.

* Excessive permeability rate can cause pollution of ground water.
**See map unit description for the composition and behavior of the map unit.

TABLE 9.--CONSTRUCTION MATERIALS

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," and "unsuited." Absence of an entry means soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
6 Aastad	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
33B, 33B2 Barnes	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
36 Flom	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
51 La Prairie	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
70 Svea	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
86 Canisteo	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
114 Glencoe	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
127, 127B Sverdrup	Good	Good	Unsuited: excess fines.	Good.
149B, 149B2 Everly	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
149C2 Everly	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, too clayey.
168B, 168B2 Forman	Fair: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
184 Hamerly	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
210 Fulda	Poor: shrink-swell, low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
212 Sinai	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
219 Rolfe	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
236 Vallers	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
241 Letri	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
246 Marysland	Poor: wetness.	Fair: excess fines.	Poor: excess fines.	Good.

TABLE 9.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
276----------------- Oldham	Poor: low strength, shrink-swell, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
284B, 284B2, 284C2---- Poinsett	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
335----------------- Urness	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
339, 339B------------ Fordville	Good-----------------	Good-----------------	Good-----------------	Good.
341, 341B------------ Arvilla	Good-----------------	Good-----------------	Good-----------------	Fair: thin layer.
341C---------------- Arvilla	Good-----------------	Good-----------------	Good-----------------	Fair: thin layer, slope.
344----------------- Quam	Poor: wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
345----------------- Wilmonton	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
347----------------- Malachy	Good-----------------	Fair: excess fines.	Unsuited: excess fines.	Good.
402E---------------- Sioux	Fair: slope.	Good-----------------	Good-----------------	Poor: slope, small stones.
418----------------- Lamoure	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
421B, 421B2---------- Ves	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
423----------------- Seaforth	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
437E---------------- Buse	Fair: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
437F---------------- Buse	Poor: slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
446----------------- Normania	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
450----------------- Rauville	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
494B---------------- Darnen	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
894D2*:				
Storden-------------	Fair: slope, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.

See footnote at end of table.

TABLE 9.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
894D2*:				
Everly	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines	Fair: slope, too clayey.
902C2*:				
Barnes	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
Buse	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
904B2*:				
Arvilla	Good	Good	Good	Fair: thin layer.
Barnes	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Buse	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
904C2*:				
Arvilla	Good	Good	Good	Fair: thin layer, slope.
Buse	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
Barnes	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
913D2*:				
Buse	Fair: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Barnes	Fair: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
915C2*:				
Forman	Fair: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, slope.
Buse	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
915D2*:				
Buse	Fair: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Forman	Fair: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, slope.
917D2*:				
Buse	Fair: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Sioux	Fair: slope.	Good	Good	Poor: slope, small stones.

See footnote at end of table.

TABLE 9.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
917E*:				
Buse	Poor: slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Sioux	Poor: slope.	Good	Good	Poor: slope, small stones.
953C*:				
Arvilla	Good	Good	Good	Fair: thin layer, slope.
Storden	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
Ves	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
954C2*:				
Storden	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
Ves	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
954D2*:				
Storden	Fair: slope, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Ves	Fair: slope, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
986*:				
Lamoure	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
La Prairie	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
1016*. Udorthents				
1029*. Pits, gravel				
1032*. Aquents and Udorthents				
1053*. Aquolls and Aquents				
1809* Bearden	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer.
1810* Colvin	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
1814 Oldham	Poor: low strength, shrink-swell, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness, too clayey.

* See map unit description for the composition and behavior of the map unit.

TABLE 10.--WATER MANAGEMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. Absence of an entry means soil was not evaluated]

Soil name and map symbol	Pond reservoir areas	Embankments dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
6 Aastad	Favorable	Favorable	Slow refill	Not needed	Not needed	Favorable.
33B, 33B2 Barnes	Seepage	Favorable	No water	Not needed	Complex slope	Favorable.
36 Flom	Favorable	Wetness	Slow refill	Frost action	Not needed	Wetness.
51 La Prairie	Seepage	Favorable	Deep to water, slow refill.	Not needed	Not needed	Favorable.
70 Svea	Seepage	Favorable	Deep to water, slow refill.	Not needed	Favorable	Erodes easily.
86 Canisteo	Seepage	Wetness	Slow refill	Frost action	Not needed	Wetness.
114 Glencoe	Seepage	Wetness, hard to pack.	Slow refill	Floods, frost action.	Not needed	Wetness.
127 Sverdrup	Seepage	Piping, seepage.	No water	Not needed	Not needed	Droughty.
127B Sverdrup	Seepage	Piping, seepage.	No water	Not needed	Too sandy	Droughty.
149B, 149B2 Everly	Favorable	Favorable	No water	Not needed	Favorable	Favorable.
149C2 Everly	Seepage	Favorable	No water	Not needed	Favorable	Slope.
168B, 168B2 Forman	Favorable	Favorable	No water	Not needed	Complex slope	Favorable.
184 Hamerly	Seepage	Favorable	Slow refill	Not needed	Wetness	Erodes easily.
210 Fulda	Favorable	Hard to pack, wetness.	Slow refill	Percs slowly, frost action.	Not needed	Wetness, percs slowly.
212 Sinai	Favorable	Hard to pack	No water	Not needed	Not needed	Percs slowly.
219 Rolfe	Favorable	Wetness	Slow refill	Floods, percs slowly, frost action.	Not needed	Wetness, erodes easily.
236 Vallers	Favorable	Wetness	Slow refill	Frost action	Not needed	Wetness.
241 Letri	Favorable	Wetness	Slow refill	Favorable	Not needed	Wetness.
246 Marysland	Seepage	Seepage, wetness.	Favorable	Floods, frost action.	Not needed	Wetness, droughty.
276 Oldham	Favorable	Hard to pack, wetness.	Slow refill	Floods, percs slowly, poor outlets.	Not needed	Wetness.
284B, 284B2, 284C2 Poinsett	Seepage	Favorable	No water	Not needed	Erodes easily	Erodes easily.

TABLE 10.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
335----------------- Urness	Favorable-------	Piping, wetness.	Slow refill----	Floods, frost action.	Not needed-----	Wetness.
339----------------- Fordville	Seepage---------	Seepage---------	No water--------	Not needed-----	Not needed-----	Favorable.
339B---------------- Fordville	Seepage---------	Seepage---------	No water--------	Not needed-----	Too sandy------	Favorable.
341----------------- Arvilla	Seepage---------	Seepage---------	No water--------	Not needed-----	Not needed-----	Droughty.
341B---------------- Arvilla	Seepage---------	Seepage---------	No water--------	Not needed-----	Too sandy, soil blowing.	Droughty.
341C---------------- Arvilla	Seepage---------	Seepage---------	No water--------	Not needed-----	Too sandy, soil blowing.	Slope, droughty.
344----------------- Quam	Favorable-------	Wetness---------	Slow refill----	Floods, frost action.	Not needed-----	Wetness.
345----------------- Wilmonton	Seepage---------	Favorable-------	Deep to water, slow refill.	Not needed-----	Not needed-----	Favorable.
347----------------- Malachy	Seepage---------	Seepage---------	Deep to water	Not needed-----	Not needed-----	Droughty.
402E---------------- Sioux	Seepage---------	Seepage---------	No water--------	Not needed-----	Slope, too sandy.	Slope, droughty.
418----------------- Lamoure	Seepage---------	Hard to pack, wetness.	Slow refill----	Floods, frost action.	Not needed-----	Wetness.
421B, 421B2-------- Ves	Seepage---------	Favorable-------	No water--------	Not needed-----	Complex slope	Favorable.
423----------------- Seaforth	Seepage---------	Favorable-------	Deep to water, slow refill.	Not needed-----	Favorable------	Favorable.
437E, 437F--------- Buse	Seepage, slope.	Favorable-------	No water--------	Not needed-----	Slope----------	Slope, erodes easily.
446----------------- Normania	Seepage---------	Favorable-------	Deep to water, slow refill.	Not needed-----	Favorable------	Favorable.
450----------------- Rauville	Seepage---------	Wetness, hard to pack.	Slow refill----	Floods, frost action.	Not needed-----	Wetness.
494B---------------- Darnen	Favorable-------	Favorable-------	No water--------	Not needed-----	Favorable------	Favorable.
894D2*:						
Storden-----------	Slope, seepage.	Favorable-------	No water--------	Not needed-----	Slope----------	Slope, erodes easily.
Everly------------	Seepage---------	Favorable-------	No water--------	Not needed-----	Favorable------	Slope.
902C2*:						
Barnes------------	Seepage---------	Favorable-------	No water--------	Not needed-----	Complex slope	Slope.
Buse--------------	Seepage---------	Favorable-------	No water--------	Not needed-----	Favorable------	Slope, erodes easily.
904B2*:						
Arvilla-----------	Seepage---------	Seepage---------	No water--------	Not needed-----	Too sandy, soil blowing.	Droughty.
Barnes------------	Seepage---------	Favorable-------	No water--------	Not needed-----	Complex slope	Favorable.
Buse--------------	Seepage---------	Favorable-------	No water--------	Not needed-----	Favorable------	Erodes easily.

See footnote at end of table.

TABLE 10.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
904C2*:						
Arvilla	Seepage	Seepage	No water	Not needed	Too sandy, soil blowing.	Slope, droughty.
Buse	Seepage	Favorable	No water	Not needed	Favorable	Slope, erodes easily.
Barnes	Seepage	Favorable	No water	Not needed	Complex slope	Slope.
913D2*:						
Buse	Seepage, slope.	Favorable	No water	Not needed	Slope	Slope, erodes easily.
Barnes	Slope	Favorable	No water	Not needed	Slope	Slope.
915C2*:						
Forman	Favorable	Favorable	No water	Not needed	Complex slope	Slope.
Buse	Seepage	Favorable	No water	Not needed	Favorable	Slope, erodes easily.
915D2*:						
Buse	Seepage, slope.	Favorable	No water	Not needed	Slope	Slope, erodes easily.
Forman	Slope	Favorable	No water	Not needed	Slope	Slope.
917D2*, 917E*:						
Buse	Seepage, slope.	Favorable	No water	Not needed	Slope	Slope, erodes easily.
Sioux	Seepage	Seepage	No water	Not needed	Slope, too sandy.	Slope, droughty.
953C*:						
Arvilla	Seepage	Seepage	No water	Not needed	Too sandy, soil blowing.	Slope, droughty.
Storden	Seepage	Favorable	No water	Not needed	Complex slope	Slope, erodes easily.
Ves	Seepage	Favorable	No water	Not needed	Complex slope	Slope.
954C2*:						
Storden	Seepage	Favorable	No water	Not needed	Complex slope	Slope, erodes easily.
Ves	Seepage	Favorable	No water	Not needed	Complex slope	Slope.
954D2*:						
Storden	Slope, seepage.	Favorable	No water	Not needed	Slope	Slope, erodes easily.
Ves	Slope, seepage.	Favorable	No water	Not needed	Slope	Slope.
986*:						
Lamoure	Seepage	Hard to pack, wetness.	Slow refill	Floods, frost action.	Not needed	Wetness.
La Prairie	Seepage	Favorable	Deep to water, slow refill.	Not needed	Not needed	Favorable.
1016*. Udorthents						
1029*. Pits, gravel						

See footnote at end of table.

TABLE 10.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
1032*. Aquents and Udorthents						
1053*. Aquolls and Aquents						
1809*------------- Bearden	Favorable------	Favorable------	Deep to water, slow refill.	Not needed-----	Not needed-----	Favorable.
1810*------------- Colvin	Favorable------	Wetness--------	Slow refill----	Floods, frost action.	Not needed-----	Wetness.
1814-------------- Oldham	Favorable------	Hard to pack, wetness.	Slow refill----	Floods, percs slowly, poor outlets.	Not needed-----	Wetness.

* See map unit description for the composition and behavior of the map unit.

TABLE 11.--RECREATIONAL DEVELOPMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
6 Aastad	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey.
33B, 33B2 Barnes	Slight	Slight	Moderate: slope.	Slight.
36 Flom	Severe: floods, wetness.	Moderate: wetness, too clayey.	Severe: wetness.	Moderate: too clayey, wetness.
51 La Prairie	Severe: floods.	Slight	Moderate: floods.	Slight.
70 Svea	Slight	Slight	Moderate: slope.	Slight.
86 Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness.
114 Glencoe	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.
127 Sverdrup	Slight	Slight	Slight	Slight.
127B Sverdrup	Slight	Slight	Moderate: slope.	Slight.
149B, 149B2 Everly	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.
149C2 Everly	Moderate: slope, too clayey.	Moderate: slope, too clayey.	Severe: slope.	Moderate: too clayey.
168B, 168B2 Forman	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Moderate: too clayey, slope, percs slowly.	Moderate: too clayey.
184 Hamerly	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
210 Fulda	Severe: wetness, floods, too clayey.	Severe: wetness, too clayey.	Severe: too clayey.	Severe: wetness, too clayey.
212 Sinai	Severe: percs slowly, too clayey.	Severe: too clayey.	Severe: too clayey, percs slowly.	Severe: too clayey.
219 Rolfe	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.
236 Vallers	Severe: wetness, floods.	Severe: wetness.	Severe: wetness.	Moderate: wetness.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
241 Letri	Severe: wetness, floods.	Severe: wetness.	Severe: wetness.	Severe: wetness.
246 Marysland	Severe: wetness, floods.	Severe: wetness.	Severe: wetness.	Moderate: wetness.
276 Oldham	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.
284B, 284B2 Poinsett	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey, slope.	Moderate: too clayey.
284C2 Poinsett	Moderate: too clayey.	Moderate: too clayey.	Severe: slope.	Moderate: too clayey.
335 Urness	Severe: floods, wetness.	Severe: wetness.	Severe: floods, wetness.	Severe: wetness.
339 Fordville	Slight	Slight	Slight	Slight.
339B Fordville	Slight	Slight	Moderate: slope.	Slight.
341 Arvilla	Slight	Slight	Slight	Slight.
341B Arvilla	Slight	Slight	Moderate: slope.	Slight.
341C Arvilla	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
344 Quam	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.
345 Wilmonton	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
347 Malachy	Slight	Slight	Slight	Slight.
402E Sioux	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope, small stones.
418 Lamoure	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Moderate: wetness, too clayey.
421B, 421B2 Ves	Slight	Slight	Moderate: slope.	Slight.
423 Seaforth	Slight	Slight	Moderate: slope.	Slight.
437E Buse	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
437F Buse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
446 Normania	Slight	Slight	Moderate: slope.	Slight.
450 Rauville	Severe: floods, wetness.	Severe: wetness.	Severe: floods, wetness.	Severe: wetness.
494B Darnen	Slight	Slight	Moderate: slope.	Slight.
894D2*:				
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Everly	Moderate: slope, too clayey.	Moderate: slope, too clayey.	Severe: slope.	Moderate: too clayey.
902C2*:				
Barnes	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Buse	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
904B2*:				
Arvilla	Slight	Slight	Moderate: slope.	Slight.
Barnes	Slight	Slight	Moderate: slope.	Slight.
Buse	Slight	Slight	Moderate: slope.	Slight.
904C2*:				
Arvilla	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Buse	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Barnes	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
913D2*:				
Buse	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Barnes	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
915C2*:				
Forman	Moderate: too clayey, slope, percs slowly.	Moderate: too clayey, slope.	Severe: slope.	Moderate: too clayey.
Buse	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
915D2*:				
Buse	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.

See footnote at end of table.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
915D2*:				
Forman	Moderate: too clayey, slope, percs slowly.	Moderate: too clayey, slope.	Severe: slope.	Moderate: too clayey.
917D2*:				
Buse	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Sioux	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope, small stones.
917E*:				
Buse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Sioux	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.
953C*:				
Arvilla	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Storden	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Ves	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
954C2*:				
Storden	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Ves	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
954D2*:				
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Ves	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
986*:				
Lamoure	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Moderate: wetness, too clayey.
La Prairie	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.
1016*. Udorthents				
1029*. Pits, gravel				
1032*. Aquents and Udorthents				
1053*. Aquolls and Aquents				

See footnote at end of table.

TABLE 11.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
1809*----------------- Bearden	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
1810*----------------- Colvin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, too clayey.
1814----------------- Oldham	Severe: floods, too clayey.	Severe: too clayey.	Severe: too clayey, wetness, floods.	Severe: too clayey.

* See map unit description for the composition and behavior of the map unit.

TABLE 12.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates the soil was not rated]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
6: Aastad	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
33B, 33B2: Barnes	Good	Good	Good	---	---	Poor	Very poor.	Good	---	Very poor.
36: Flom	Good	Good	Good	Fair	Fair	---	Good	Good	Fair	Good.
51: La Prairie	Good	Good	Good	---	---	Poor	Poor	Good	---	Poor.
70: Svea	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
86: Canisteo	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
114: Glencoe	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
127, 127B: Sverdrup	Fair	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Poor.
149B, 149B2: Everly	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
149C2: Everly	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
168B, 168B2: Forman	Good	Good	Good	---	---	Poor	Very poor.	Good	---	Very poor.
184: Hamerly	Good	Good	Good	---	---	Fair	Poor	Good	---	Poor.
210: Fulda	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Fair.
212: Sinai	Fair	Fair	Fair	---	---	Poor	Poor	Fair	---	Poor.
219: Rolfe	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
236: Vallers	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
241: Letri	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
246: Marysland	Good	Good	Fair	Fair	Fair	Poor	Poor	Fair	Fair	Poor.
276: Oldham	Good	Good	Good	Poor	Poor	Good	Good	Good	Poor	Good.
284B, 284B2: Poinsett	Good	Good	Good	---	---	Poor	Very poor.	Good	---	Very poor.
284C2: Poinsett	Fair	Good	Good	---	---	Very poor.	Very poor.	Good	---	Very poor.

TABLE 12.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
335---------------- Urness	Poor	Poor	Poor	Poor	Very poor.	Poor	Poor	Poor	Poor	Poor.
339---------------- Fordville	Good	Good	Good	---	---	Poor	Very poor.	Good	---	Very poor.
339B--------------- Fordville	Fair	Good	Good	---	---	Poor	Very poor.	Good	---	Very poor.
341, 341B---------- Arvilla	Fair	Good	Fair	---	---	Very poor.	Very poor.	Fair	---	Very poor.
341C--------------- Arvilla	Poor	Fair	Fair	---	---	Very poor.	Very poor.	Fair	---	Very poor.
344---------------- Quam	Fair	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
345---------------- Wilmonton	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
347---------------- Malachy	Fair	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
402E--------------- Sioux	Very poor.	Poor	Fair	---	---	Very poor.	Very poor.	Poor	---	Very poor.
418---------------- Lamoure	Good	Good	Good	---	---	Good	Fair	Good	---	Fair.
421B, 421B2-------- Ves	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
423---------------- Seaforth	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
437E, 437F--------- Buse	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
446---------------- Normania	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
450---------------- Rauville	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Very poor.	Poor	Good.
494B--------------- Darnen	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
894D2*:										
Storden-----------	Fair	Good	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
Everly------------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
902C2*:										
Barnes------------	Fair	Good	Good	---	---	Very poor.	Very poor.	Good	---	Very poor.
Buse--------------	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
904B2*:										
Arvilla-----------	Fair	Good	Fair	---	---	Very poor.	Very poor.	Fair	---	Very poor.

See footnote at end of table.

TABLE 12.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
904B2*:										
Barnes	Good	Good	Good	---	---	Poor	Very poor.	Good	---	Very poor.
Buse	Good	Good	Fair	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.
904C2*:										
Arvilla	Poor	Fair	Fair	---	---	Very poor.	Very poor.	Fair	---	Very poor.
Buse	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Barnes	Fair	Good	Good	---	---	Very poor.	Very poor.	Good	---	Very poor.
913D2*:										
Buse	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Barnes	Poor	Fair	Good	---	---	Very poor.	Very poor.	Fair	---	Very poor.
915C2*:										
Forman	Fair	Good	Good	---	---	Very poor.	Very poor.	Good	---	Very poor.
Buse	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
915D2*:										
Buse	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Forman	Fair	Good	Good	---	---	Very poor.	Very poor.	Good	---	Very poor.
917D2*:										
Buse	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Sioux	Very poor.	Poor	Fair	---	---	Very poor.	Very poor.	Poor	---	Very poor.
917E*:										
Buse	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Sioux	Very poor.	Poor	Fair	---	---	Very poor.	Very poor.	Poor	---	Very poor.
953C*:										
Arvilla	Poor	Fair	Fair	---	---	Very poor.	Very poor.	Fair	---	Very poor.
Storden	Fair	Good	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
Ves	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
954C2*:										
Storden	Fair	Good	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.

See footnote at end of table.

TABLE 12.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
954C2*:										
Ves	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
954D2*:										
Storden	Fair	Good	Good	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
Ves	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
986*:										
Lamoure	Fair	Fair	Good	---	---	Good	Fair	Fair	---	Fair.
La Prairie	Very poor.	Poor	Fair	---	---	Good	Poor	Poor	---	Poor.
1016*. Udorthents										
1029*. Pits, gravel										
1032*. Aquents and Udorthents										
1053*. Aquolls and Aquents										
1809* Bearden	Good	Good	Good	---	---	Fair	Fair	Good	---	Fair.
1810* Colvin	Good	Good	Good	Fair	Poor	Good	Good	Good	Poor	Good.
1814 Oldham	Good	Good	Good	---	---	Fair	Fair	Good	---	Fair.

* See map unit description for the composition and behavior of the map unit.

TABLE 13.--ENGINEERING PROPERTIES AND CLASSIFICATIONS

[The symbol < means less than; > means greater than. Absence of an entry means data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
6------------------ Aastad	0-12	Clay loam-------	CL	A-7	0-5	95-100	90-100	80-95	60-80	40-50	15-25
	12-19	Clay loam-------	CL, ML	A-6, A-7	0-5	95-100	85-100	75-95	50-75	35-50	15-25
	19-68	Clay loam, loam	CL	A-7	0-5	90-100	85-100	75-95	55-75	35-50	12-25
33B, 33B2---------- Barnes	0-11	Loam------------	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	85-100	60-90	20-40	5-15
	11-16	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	55-80	25-40	5-15
	16-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	55-80	25-40	5-15
36----------------- Flom	0-20	Clay loam-------	OL, CL-ML, CL	A-4, A-6, A-7	0	95-100	95-100	80-100	60-90	20-50	5-20
	20-39	Clay loam, silty clay loam.	CL	A-6, A-7	0	95-100	95-100	90-100	70-95	30-50	10-30
	39-60	Loam, clay loam, silty clay loam.	CL	A-6, A-7	0	95-100	95-100	80-95	60-90	20-50	10-30
51----------------- La Prairie	0-40	Loam------------	CL-ML, CL	A-4, A-6	0	100	100	85-95	70-80	25-40	5-15
	40-60	Silt loam, loam, fine sand.	CL-ML, CL, SM, SM-SC	A-4, A-6, A-2	0	100	100	85-95	30-80	<45	NP-25
70----------------- Svea	0-21	Loam------------	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-95	60-90	20-40	5-25
	21-31	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-95	60-90	20-45	5-25
	31-60	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-95	60-80	20-50	5-30
86----------------- Canisteo	0-22	Clay loam-------	OL, CL	A-7	0	98-100	95-100	85-98	60-90	40-50	15-20
	22-31	Clay loam, loam	CL	A-6	0	98-100	90-100	85-95	65-85	38-50	25-35
	31-60	Clay loam, loam	CL	A-6	0-5	95-100	90-98	80-95	60-75	30-40	12-20
114---------------- Glencoe	0-42	Silty clay loam, clay loam.	OL, OH, MH, ML	A-7	0	100	95-100	85-98	75-90	45-60	10-20
	42-47	Loam, clay loam, silty clay loam.	CL	A-7, A-6	0	100	95-100	85-98	75-90	35-50	15-25
	47-60	Loam, clay loam	CL	A-6, A-7	0	98-100	90-98	80-98	70-85	35-50	15-25
127, 127B---------- Sverdrup	0-9	Sandy loam------	SM	A-4	0	100	95-100	60-70	35-50	---	NP
	9-32	Loam, sandy loam, loamy sand.	ML, SM	A-2, A-4	0	100	95-100	50-75	30-70	<30	NP-5
	32-60	Sand, fine sand	SP, SP-SM	A-3	0	100	95-100	50-90	2-10	---	NP
149B, 149B2, 149C2- Everly	0-10	Clay loam-------	CL	A-6, A-7	0	100	95-100	85-95	65-80	30-45	11-20
	10-26	Clay loam-------	CL	A-6, A-7	0	95-100	95-100	85-95	70-90	30-50	15-25
	26-60	Loam, clay loam	CL	A-6, A-7	0	90-100	85-95	75-85	60-80	30-50	15-25
168B, 168B2-------- Forman	0-11	Clay loam-------	CL	A-6	0-5	95-100	90-100	90-100	70-80	25-40	10-25
	11-19	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-80	25-40	5-15
	19-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-80	25-40	5-15
184---------------- Hamerly	0-17	Loam------------	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-90	20-40	5-25
	17-26	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	20-45	5-25
	26-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	20-45	5-25

TABLE 13.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
210----------------- Fulda	0-17	Silty clay------	OH, CH, CL, MH	A-7	0	100	100	95-100	85-95	30-70	10-35
	17-28	Silty clay------	CH, CL	A-7	0	100	90-100	90-100	90-95	45-70	25-50
	28-60	Silty clay------	CH, CL, MH	A-7	0	100	90-100	90-100	85-95	40-70	15-30
212----------------- Sinai	0-33	Silty clay------	CL, CH, MH	A-7	0	100	100	95-100	90-100	45-70	19-45
	33-47	Silty clay, silty clay loam, clay.	CL, CH, MH	A-7	0	100	100	95-100	90-100	45-70	19-45
	47-60	Stratified silty clay to silt loam.	CL, CH	A-6, A-7	0	100	100	95-100	80-95	35-70	15-45
219----------------- Rolfe	0-20	Loam------------	OL, CL, ML, CL-ML	A-6, A-4	0	100	95-100	90-100	80-95	30-40	5-15
	20-32	Clay, silty clay, clay loam.	CH, MH	A-7	0	100	95-100	90-100	75-95	50-70	15-35
	32-60	Clay loam, loam	CL	A-7, A-6	0	95-100	90-100	80-90	55-75	30-50	10-25
236----------------- Vallers	0-15	Clay loam-------	OL, CL, ML	A-6, A-7	0	95-100	95-100	95-100	85-95	30-50	11-20
	15-25	Clay loam-------	CL	A-6	0	95-100	90-97	90-95	70-80	30-40	11-20
	25-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	95-100	90-97	85-95	60-75	20-40	5-20
241----------------- Letri	0-20	Clay loam-------	CL	A-7	0	95-100	95-100	95-100	80-95	40-50	15-25
	20-35	Clay loam, silty clay loam.	CL	A-7	0-5	95-100	90-100	85-95	75-85	40-50	15-25
	35-60	Loam, clay loam	CL	A-6, A-7, A-4	0-5	95-100	90-100	85-95	65-75	30-50	7-25
246----------------- Marysland	0-18	Loam------------	CL	A-6, A-7	0	95-100	95-100	85-95	50-80	30-50	10-25
	18-42	Loam, clay loam, fine sandy loam.	CL, SC, SM, ML	A-6, A-4	0	90-100	85-100	80-95	45-80	<40	NP
	42-60	Sand, loamy fine sand, coarse sand.	SP-SM, SM	A-1, A-2, A-3	0	70-95	50-90	35-70	5-20	---	NP
276----------------- Oldham	0-31	Silty clay loam	CL, CH, MH, ML	A-6, A-7	0	100	95-100	85-100	85-100	35-60	10-30
	31-60	Silty clay loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0	100	95-100	85-100	70-100	25-45	5-20
284B, 284B2, 284C2- Poinsett	0-11	Silty clay loam	CL, ML	A-6, A-7	0	100	100	95-100	85-100	35-50	10-25
	11-30	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	95-100	95-100	85-100	30-50	10-25
	30-60	Stratified sandy loam to silty clay loam.	CL, ML, SC, SM-SC	A-4, A-6, A-7	0	100	95-100	65-100	45-100	25-50	3-25
335----------------- Urness	0-29	Silt loam-------	OL	A-8	0	100	100	90-100	70-95	20-50	3-20
	29-60	Loam, silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	95-100	90-100	85-100	70-95	20-50	3-30
339, 339B----------- Fordville	0-10	Loam------------	ML, CL	A-4, A-6	0	100	100	70-85	55-75	30-40	5-15
	10-26	Loam------------	CL, ML	A-4, A-6	0	100	95-100	70-95	55-85	30-40	5-15
	26-60	Sand and gravel	SW, SW-SM, SP, SP-SM	A-1	0	65-85	45-70	15-40	0-10	<25	NP-5

TABLE 13.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
341, 341B, 341C---- Arvilla	0-9	Sandy loam------	SM, SC, SM-SC	A-2, A-4	0	100	100	60-80	30-45	10-30	NP-10
	9-19	Coarse sandy loam, sandy loam.	SM, SC, SM-SC	A-2, A-4	0	95-100	90-100	60-70	30-40	10-30	NP-10
	19-60	Sand and gravel	SP-SM, GP, SP, GP-GM	A-1	0	35-95	25-80	10-50	0-10	---	NP
344---------------- Quam	0-43	Silty clay loam	OL, CL	A-6, A-7	0	100	100	90-100	85-95	30-50	11-20
	43-60	Silty clay loam, clay loam, silt loam.	CL, ML, CL-ML	A-4, A-6, A-7	0	100	90-100	85-95	70-90	20-50	5-20
345---------------- Wilmonton	0-18	Clay loam-------	CL, OL	A-6, A-7	0	100	92-100	85-97	60-90	25-50	12-25
	18-31	Clay loam, silty clay loam.	CL	A-6, A-7	0-5	95-100	92-100	85-100	60-85	25-50	15-25
	31-60	Clay loam, loam	CL, ML	A-6	0-5	95-100	87-97	75-85	55-75	25-40	14-25
347---------------- Malachy	0-15	Loam------------	ML	A-4	0	100	95-100	80-95	50-75	25-35	1-10
	15-36	Loam, fine sandy loam, sandy loam.	SM, ML	A-4	0	100	95-100	60-95	35-75	15-35	NP-10
	36-60	Fine sand, sand, loamy coarse sand.	SM, SP-SM	A-1, A-2, A-3	0	95-100	90-100	30-80	5-35	<20	NP
402E--------------- Sioux	0-11	Gravelly sandy loam, loam.	SM, SC, ML, CL	A-2, A-4, A-1	0	60-100	45-100	30-90	15-80	<30	NP-10
	11-60	Sand and gravel	GM, GP, SM, SP	A-1	0	25-75	10-60	5-35	0-25	<25	NP-5
418---------------- Lamoure	0-25	Silty clay loam	CL, CH, MH	A-6, A-7	0	100	100	95-100	85-100	45-60	20-30
	25-38	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	90-100	85-100	40-60	15-30
	38-60	Stratified sandy loam to silty clay loam.	CL, SC	A-6, A-7	0	100	95-100	70-95	35-90	30-50	10-30
421B, 421B2-------- Ves	0-11	Loam------------	CL, OL	A-6, A-4	0-5	95-100	90-100	80-100	60-80	30-40	7-15
	11-21	Loam, clay loam	CL, ML	A-6	0-5	95-100	90-100	80-95	55-75	30-40	10-20
	21-60	Loam------------	CL, ML	A-6, A-4	0-5	90-100	85-95	80-90	55-80	30-40	7-15
423---------------- Seaforth	0-15	Loam------------	ML, OL	A-7, A-6, A-4	0-5	95-100	90-100	80-100	60-80	35-45	8-15
	15-24	Loam, clay loam	CL, ML	A-6, A-4	0-5	90-100	85-100	80-95	55-80	30-40	8-15
	24-60	Loam------------	CL, ML	A-6, A-4	0-5	90-100	85-95	80-90	55-80	30-40	8-15
437E, 437F--------- Buse	0-7	Loam------------	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	55-80	20-40	3-20
	7-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	60-80	25-40	5-15
446---------------- Normania	0-17	Loam------------	CL, OL	A-6, A-4	0-5	95-100	90-100	80-100	60-80	30-40	8-15
	17-26	Loam, clay loam	CL, ML	A-6, A-4	0-5	95-100	90-100	80-95	55-75	25-40	8-20
	26-60	Loam------------	CL, ML	A-6, A-4	0-5	90-100	85-95	80-90	55-80	30-40	8-15
450---------------- Rauville	0-38	Silty clay loam	CL, CH	A-6, A-7	0	100	100	90-100	85-100	35-60	15-30
	38-60	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	90-100	85-100	35-60	15-30
494B--------------- Darnen	0-27	Loam------------	OL, ML, CL	A-4	0	100	100	85-100	60-90	20-35	2-10
	27-42	Loam, clay loam	CL, CL-ML	A-4, A-6 A-7	0	100	100	85-100	60-90	20-45	5-25
	42-60	Loam, clay loam	CL, CL-ML	A-4, A-6 A-7	0	90-100	90-100	80-95	60-85	20-45	5-25

TABLE 13.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
894D2*:											
Storden-----------	0-7	Loam------------	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
	7-60	Loam------------	CL-ML, CL	A-4, A-6	0-5	95-100	85-97	70-85	55-70	20-40	5-15
Everly------------	0-7	Clay loam-------	CL	A-6, A-7	0	100	95-100	85-95	65-80	30-45	11-20
	7-19	Clay loam-------	CL	A-6, A-7	0	95-100	95-100	85-95	70-90	30-50	15-25
	19-60	Loam, clay loam	CL	A-6, A-7	0	90-100	85-95	75-85	60-80	30-50	15-25
902C2*:											
Barnes------------	0-7	Loam------------	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	85-100	60-90	20-40	5-15
	7-12	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	55-80	25-40	5-15
	12-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	55-80	25-40	5-15
Buse--------------	0-7	Loam------------	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	55-80	20-40	3-20
	7-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	60-80	25-40	5-15
904B2*:											
Arvilla-----------	0-6	Sandy loam------	SM, SC, SM-SC	A-2, A-4	0	100	100	60-80	30-45	10-30	NP-10
	6-16	Coarse sandy loam, sandy loam.	SM, SC, SM-SC	A-2, A-4	0	95-100	90-100	60-70	30-40	10-30	NP-10
	16-60	Sand and gravel	SP-SM, GP, SP, GP-GM	A-1	0	35-95	25-80	10-50	0-10	---	NP
Barnes------------	0-7	Loam------------	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	85-100	60-90	20-40	5-15
	7-12	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	55-80	25-40	5-15
	12-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	55-80	25-40	5-15
Buse--------------	0-7	Loam------------	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	55-80	20-40	3-20
	7-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	60-80	25-40	5-15
904C2*:											
Arvilla-----------	0-6	Sandy loam------	SM, SC, SM-SC	A-2, A-4	0	100	100	60-80	30-45	10-30	NP-10
	6-14	Coarse sandy loam, sandy loam.	SM, SC, SM-SC	A-2, A-4	0	95-100	90-100	60-70	30-40	10-30	NP-10
	14-60	Sand and gravel	SP-SM, GP, SP, GP-GM	A-1	0	35-95	25-80	10-50	0-10	---	NP
Buse--------------	0-7	Loam------------	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	55-80	20-40	3-20
	7-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	60-80	25-40	5-15
Barnes------------	0-7	Loam------------	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	85-100	60-90	20-40	5-15
	7-12	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	55-80	25-40	5-15
	12-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	55-80	25-40	5-15
913D2*:											
Buse--------------	0-7	Loam------------	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	55-80	20-40	3-20
	7-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	60-80	25-40	5-15
Barnes------------	0-8	Loam------------	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	85-100	60-90	20-40	5-15
	8-20	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	55-80	25-40	5-15
	20-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	55-80	25-40	5-15
915C2*:											
Forman------------	0-7	Clay loam-------	CL	A-6	0-5	95-100	90-100	90-100	70-80	25-40	10-25
	7-14	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-80	25-40	5-15
	14-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-80	25-40	5-15

See footnote at end of table.

TABLE 13.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
915C2*:											
Buse	0-7	Loam	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	55-80	20-40	3-20
	7-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	60-80	25-40	5-15
915D2*:											
Buse	0-7	Loam	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	55-80	20-40	3-20
	7-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	60-80	25-40	5-15
Forman	0-7	Clay loam	CL	A-6	0-5	95-100	90-100	90-100	70-80	25-40	10-25
	7-14	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-80	25-40	5-15
	14-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-80	25-40	5-15
917D2*:											
Buse	0-7	Loam	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	55-80	20-40	3-20
	7-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	60-80	25-40	5-15
Sioux	0-7	Gravelly sandy loam, loam.	SM, SC, ML, CL	A-2, A-4, A-1	0	60-100	45-100	30-90	15-80	<30	NP-10
	7-60	Sand and gravel	GM, GP, SM, SP	A-1	0	25-75	10-60	5-35	0-25	<25	NP-5
917E*:											
Buse	0-7	Loam	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	55-80	20-40	3-20
	7-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	60-80	25-40	5-15
Sioux	0-7	Gravelly sandy loam, loam.	SM, SC, ML, CL	A-2, A-4, A-1	0	60-100	45-100	30-90	15-80	<30	NP-10
	7-60	Sand and gravel	GM, GP, SM, SP	A-1	0	25-75	10-60	5-35	0-25	<25	NP-5
953C*:											
Arvilla	0-8	Sandy loam	SM, SC, SM-SC	A-2, A-4	0	100	100	60-80	30-45	10-30	NP-10
	8-16	Coarse sandy loam, sandy loam.	SM, SC, SM-SC	A-2, A-4	0	95-100	90-100	60-70	30-40	10-30	NP-10
	16-60	Sand and gravel	SP-SM, GP, SP, GP-GM	A-1	0	35-95	25-80	10-50	0-10	---	NP
Storden	0-8	Loam	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
	8-60	Loam	CL-ML, CL	A-4, A-6	0-5	95-100	85-97	70-85	55-70	20-40	5-15
Ves	0-8	Loam	CL, OL	A-6, A-4	0-5	95-100	90-100	80-100	60-80	30-40	7-15
	8-18	Loam, clay loam	CL, ML	A-6	0-5	95-100	90-100	80-95	55-75	30-40	10-20
	18-60	Loam	CL, ML	A-6, A-4	0-5	90-100	85-95	80-90	55-80	30-40	7-15
954C2*, 954D2*:											
Storden	0-8	Loam	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
	8-60	Loam	CL-ML, CL	A-4, A-6	0-5	95-100	85-97	70-85	55-70	20-40	5-15
Ves	0-8	Loam	CL, OL	A-6, A-4	0-5	95-100	90-100	80-100	60-80	30-40	7-15
	8-18	Loam, clay loam	CL, ML	A-6	0-5	95-100	90-100	80-95	55-75	30-40	10-20
	18-60	Loam	CL, ML	A-6, A-4	0-5	90-100	85-95	80-90	55-80	30-40	7-15
986*:											
Lamoure	0-25	Silty clay loam	CL, CH, MH	A-6, A-7	0	100	100	95-100	85-100	45-60	20-30
	25-38	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	90-100	85-100	40-60	15-30
	38-60	Stratified sandy loam to silty clay loam.	CL, SC	A-6, A-7	0	100	95-100	70-95	35-90	30-50	10-30

See footnote at end of table.

TABLE 13.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
986*:											
La Prairie--------	0-40	Loam------------	CL-ML, CL	A-4, A-6	0	100	100	85-95	70-80	25-40	5-15
	40-60	Silt loam, loam, fine sand.	CL-ML, CL, SM, ML	A-4, A-6, A-2	0	100	100	85-95	30-80	<40	NP-25
1016*. Udorthents											
1029*. Pits, gravel											
1032*. Aquents and Udorthents											
1053*. Aquolls and Aquents											
1809*-------------- Bearden	0-14	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	80-95	30-50	10-25
	14-37	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	30-50	10-25
	37-60	Loam, clay loam	CL	A-6, A-7	0	100	100	90-100	70-95	30-50	10-25
1810*-------------- Colvin	0-14	Clay loam, silt loam.	CL	A-6, A-7	0	100	100	90-100	80-95	35-50	15-30
	14-60	Loam, silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	90-100	80-95	25-50	10-30
1814--------------- Oldham	0-33	Silty clay------	CL, CH, MH, ML	A-6, A-7	0	100	95-100	85-100	85-100	35-60	10-30
	33-60	Silty clay loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0	100	95-100	85-100	70-100	25-45	5-20

* See map unit description for the composition and behavior of the map unit.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means greater than. The erosion tolerance factor (T) is for the entire profile. Absence of an entry means data were not available or were not estimated]

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm						
6	0-12	0.6-2.0	0.17-0.19	6.6-7.8	<2	Moderate	High	Low	0.24	5	6
Aastad	12-19	0.2-0.6	0.15-0.19	6.6-7.8	<2	Moderate	High	Low	0.24		
	19-68	0.2-0.6	0.14-0.16	7.4-8.4	<2	Moderate	High	Low	0.32		
33B, 33B2	0-11	0.6-2.0	0.13-0.24	6.6-7.3	<2	Low	High	Low	0.28	5	6
Barnes	11-16	0.6-2.0	0.15-0.19	6.6-7.8	<2	Low	High	Low	0.28		
	16-60	0.6-2.0	0.14-0.19	7.4-8.4	<2	Low	Moderate	Low	0.37		
36	0-20	0.2-2.0	0.17-0.24	6.6-7.3	<2	Moderate	High	Low	0.28	5	6
Flom	20-39	0.2-0.6	0.15-0.19	7.4-8.4	<2	Moderate	High	Low	0.28		
	39-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	High	Low	0.28		
51	0-40	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	Moderate	Low	0.28	5	6
La Prairie	40-60	0.6-2.0	0.15-0.20	7.4-8.4	<2	Moderate	Moderate	Low	0.28		
70	0-21	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low	High	Low	0.28	5	6
Svea	21-31	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate	High	Low	0.28		
	31-60	0.6-2.0	0.14-0.19	7.4-8.4	<2	Moderate	High	Low	0.37		
86	0-22	0.6-2.0	0.18-0.22	7.4-8.4	<2	Moderate	High	Low	0.28	5	4L
Canisteo	22-31	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	High	Low*	0.28		
	31-60	0.6-2.0	0.14-0.16	7.4-8.4	<2	Moderate	High	Low*	0.28		
114	0-42	0.2-0.6	0.18-0.22	6.1-7.8	<2	Moderate	High	Low	0.28	5	6
Glencoe	42-47	0.2-0.6	0.15-0.19	6.6-7.8	<2	Moderate	High	Low	0.28		
	47-60	0.2-0.6	0.15-0.19	7.4-7.8	<2	Moderate	High	Low	0.28		
127, 127B	0-9	2.0-6.0	0.13-0.15	6.1-7.3	<2	Low	Low	Low	0.20	3	3
Sverdrup	9-32	2.0-6.0	0.09-0.19	6.1-7.8	<2	Low	Low	Low	0.20		
	32-60	6.0-20	0.05-0.08	7.4-8.4	<2	Low	Low	Low	0.15		
149B, 149B2, 149C2	0-10	0.6-2.0	0.17-0.19	5.6-6.5	<2	Moderate	Moderate	Moderate	0.24	5	6
Everly	10-26	0.6-2.0	0.15-0.17	6.1-7.3	<2	Moderate	Moderate	Moderate	0.32		
	26-60	0.2-0.6	0.17-0.19	7.4-8.4	<2	Moderate	Moderate	Low	0.32		
168B, 168B2	0-11	0.6-2.0	0.17-0.19	6.6-7.3	<2	Moderate	High	Low	0.28	5	6
Forman	11-19	0.6-2.0	0.15-0.19	6.6-7.8	<2	Moderate	High	Low	0.28		
	19-60	0.2-0.6	0.14-0.19	7.9-8.4	<2	Moderate	Moderate	Low	0.37		
184	0-17	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	High	Low	0.28	5	4L
Hamerly	17-26	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	High	Low	0.28		
	26-60	0.2-2.0	0.14-0.19	7.4-8.4	<2	Moderate	High	Low	0.37		
210	0-17	0.06-0.6	0.14-0.22	6.6-7.3	<2	High	High	Low	0.28	5	4
Fulda	17-28	0.06-0.2	0.13-0.16	7.4-8.4	<2	High	High	Low	0.28		
	28-60	0.2-0.6	0.16-0.19	7.9-8.4	<2	High	High	Low	0.28		
212	0-33	0.06-0.2	0.13-0.16	6.1-7.3	<2	High	High	Low	0.28	5	4
Sinai	33-47	0.06-0.2	0.11-0.17	7.4-8.4	<2	High	High	Low	0.28		
	47-60	0.06-0.2	0.11-0.17	7.4-8.4	<2	High	High	Low	0.43		
219	0-20	0.6-2.0	0.22-0.24	5.1-6.5	<2	Moderate	High	Moderate	0.28	5	6
Rolfe	20-32	0.06-0.2	0.11-0.13	6.1-7.3	<2	High	High	Moderate	0.28		
	32-60	0.2-2.0	0.14-0.16	6.1-8.4	<2	Moderate	High	Low	0.28		
236	0-15	0.2-0.6	0.18-0.22	7.4-8.4	<2	Moderate	High	Low	0.28	5	4L
Vallers	15-25	0.2-0.6	0.15-0.19	7.9-8.4	<2	Low	High	Low*	0.28		
	25-60	0.2-0.6	0.17-0.19	7.4-8.4	<2	Low	High	Low*	0.28		

See footnotes at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm						
241	0-20	0.6-6.0	0.18-0.22	6.6-7.3	<2	Moderate	High	Low	0.28	5	7
Letri	20-35	0.6-2.0	0.15-0.19	6.6-7.8	<2	Moderate	High	Low	0.28		
	35-60	0.2-2.0	0.17-0.19	7.4-8.4	<2	Moderate	High	Low	0.28		
246	0-18	0.6-2.0	0.17-0.22	7.9-8.4	<2	Moderate	High	Low	0.28	4	4L
Marysland	18-42	0.6-2.0	0.15-0.19	7.9-8.4	<2	Moderate	High	Low	0.28		
	42-60	>6.0	0.02-0.07	7.9-8.4	<2	Low	High	Low	0.15		
276	0-31	0.06-0.2	0.13-0.19	6.6-7.8	<4	High	High	Moderate	0.28	5	4L
Oldham	31-60	0.06-0.6	0.14-0.20	7.4-8.4	<2	Moderate	High	Moderate	0.43		
284B, 284B2, 284C2	0-11	0.6-2.0	0.19-0.22	6.1-7.3	<2	Moderate	Moderate	Low	0.32	5	7
Poinsett	11-30	0.6-2.0	0.18-0.21	6.1-8.4	<2	Moderate	High	Low	0.43		
	30-60	0.6-2.0	0.12-0.20	7.4-8.4	<2	Moderate	High	Low	0.43		
335	0-29	0.6-2.0	0.18-0.24	7.4-8.4	<2	Moderate	High	Low*	---	---	4L
Urness	29-60	0.6-2.0	0.16-0.22	7.4-8.4	<2	Moderate	High	Low*	---		
339, 339B	0-10	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low	Low	Low	0.24	4	6
Fordville	10-26	0.6-2.0	0.18-0.21	6.1-7.8	<2	Low	Low	Low	0.24		
	26-60	6.0-20	0.03-0.06	7.4-8.4	<2	Low	Moderate	Low	0.10		
341, 341B, 341C	0-9	2.0-6.0	0.13-0.15	6.6-7.3	<2	Low	Moderate	Low	0.20	3	3
Arvilla	9-19	2.0-6.0	0.13-0.15	6.6-7.8	<2	Low	Moderate	Low	0.20		
	19-60	>6.0	0.02-0.05	7.4-8.4	<2	Low	Moderate	Low	0.10		
344	0-43	0.2-0.6	0.18-0.22	6.6-7.8	<2	Moderate	High	Low	0.28	5	7
Quam	43-60	0.2-0.6	0.14-0.16	7.4-8.4	<2	Moderate	High	Low	0.28		
345	0-18	0.6-2.0	0.20-0.26	6.6-7.3	<2	Moderate	Moderate	Low	0.28	5	6
Wilmonton	18-31	0.2-0.6	0.15-0.19	6.1-7.8	<2	Moderate	Moderate	Low	0.28		
	31-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	Moderate	Low	0.37		
347	0-15	0.6-2.0	0.20-0.22	7.4-7.8	<2	Low	Low	Low	0.20	4	5
Malachy	15-36	0.6-6.0	0.12-0.19	7.4-7.8	<2	Low	Low	Low	0.20		
	36-60	6.0-20	0.02-0.07	7.4-7.8	<2	Low	Low	Low	0.20		
402E	0-11	0.6-6.0	0.10-0.20	6.6-8.4	<2	Low	Moderate	Low	0.24	2	8
Sioux	11-60	6.0-20	0.03-0.06	7.9-8.4	<2	Low	Low	Low	0.10		
418	0-25	0.6-2.0	0.19-0.22	7.4-8.4	<4	Moderate	High	Moderate	0.28	5	4L
Lamoure	25-38	0.6-2.0	0.17-0.20	7.4-8.4	<4	Moderate	High	Moderate	0.28		
	38-60	0.6-2.0	0.09-0.18	7.4-8.4	<4	Low	High	Moderate	0.28		
421B, 421B2	0-11	0.6-2.0	0.20-0.22	6.1-7.8	<2	Moderate	Moderate	Low	0.24	5	6
Ves	11-21	0.6-2.0	0.17-0.19	6.6-7.8	<2	Moderate	Moderate	Low	0.24		
	21-60	0.6-2.0	0.17-0.19	7.4-8.4	<2	Low	Moderate	Low	0.24		
423	0-15	0.6-2.0	0.20-0.22	7.4-8.4	<2	Moderate	High	Low	0.28	5	4L
Seaforth	15-24	0.6-2.0	0.17-0.19	7.4-8.4	<2	Low	High	Low	0.28		
	24-60	0.6-2.0	0.17-0.19	7.4-8.4	<2	Low	High	Low	0.28		
437E, 437F	0-7	0.6-2.0	0.17-0.22	6.6-8.4	<2	Moderate	Low	Low	0.28	5	4L
Buse	7-60	0.2-2.0	0.14-0.19	7.4-8.4	<2	Moderate	Low	Low	0.37		
446	0-17	0.6-2.0	0.20-0.22	6.1-7.3	<2	Moderate	Moderate	Low	0.24	5	6
Normania	17-26	0.6-2.0	0.17-0.19	6.6-7.8	<2	Moderate	Moderate	Low	0.24		
	26-60	0.6-2.0	0.17-0.19	7.4-8.4	<2	Low	High	Low	0.37		
450	0-38	0.2-2.0	0.19-0.22	7.4-8.4	<2	Moderate	High	Moderate	0.28	5	4L
Rauville	38-60	0.2-2.0	0.17-0.20	7.4-8.4	<2	Moderate	High	Moderate	0.28		

See footnotes at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T	Wind erodi-bility group
	In	In/hr	In/in	pH	Mmhos/cm						
494B: Darnen	0-27	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low	High	Low	0.28	5	6
	27-42	0.6-2.0	0.15-0.19	6.6-7.8	<2	Moderate	High	Low	0.28		
	42-60	0.6-2.0	0.14-0.19	7.4-8.4	<2	Moderate	High	Low	0.37		
894D2**:											
Storden	0-7	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low	Low	Low	0.28	5	4L
	7-60	0.6-2.0	0.17-0.19	7.4-8.4	<2	Low	Low	Low	0.37		
Everly	0-7	0.6-2.0	0.17-0.19	5.6-6.5	<2	Moderate	Moderate	Moderate	0.24	5	6
	7-19	0.6-2.0	0.15-0.17	6.1-7.3	<2	Moderate	Moderate	Moderate	0.32		
	19-60	0.2-0.6	0.17-0.19	7.4-8.4	<2	Moderate	Moderate	Low	0.32		
902C2**:											
Barnes	0-7	0.6-2.0	0.13-0.24	6.6-7.3	<2	Low	High	Low	0.28	5	6
	7-12	0.6-2.0	0.15-0.19	6.6-7.8	<2	Low	High	Low	0.28		
	12-60	0.6-2.0	0.14-0.19	7.4-8.4	<2	Low	Moderate	Low	0.37		
Buse	0-7	0.6-2.0	0.17-0.22	6.6-8.4	<2	Moderate	Low	Low	0.28	5	4L
	7-60	0.6-2.0	0.14-0.19	7.4-8.4	<2	Moderate	Low	Low	0.37		
904B2**:											
Arvilla	0-6	2.0-6.0	0.13-0.15	6.6-7.3	<2	Low	Moderate	Low	0.20	3	3
	6-16	2.0-6.0	0.13-0.15	6.6-7.8	<2	Low	Moderate	Low	0.20		
	16-60	>6.0	0.02-0.05	7.4-8.4	<2	Low	Moderate	Low	0.10		
Barnes	0-7	0.6-2.0	0.13-0.24	6.6-7.3	<2	Low	High	Low	0.28	5	6
	7-12	0.6-2.0	0.15-0.19	6.6-7.8	<2	Low	High	Low	0.28		
	12-60	0.6-2.0	0.14-0.19	7.4-8.4	<2	Low	Moderate	Low	0.37		
Buse	0-7	0.6-2.0	0.17-0.22	6.6-8.4	<2	Moderate	Low	Low	0.28	5	4L
	7-60	0.6-2.0	0.14-0.19	7.4-8.4	<2	Moderate	Low	Low	0.37		
904C2**:											
Arvilla	0-6	2.0-6.0	0.13-0.15	6.6-7.3	<2	Low	Moderate	Low	0.20	3	3
	6-14	2.0-6.0	0.13-0.15	6.6-7.8	<2	Low	Moderate	Low	0.20		
	14-60	>6.0	0.02-0.05	7.4-8.4	<2	Low	Moderate	Low	0.10		
Buse	0-7	0.6-2.0	0.17-0.22	6.6-8.4	<2	Moderate	Low	Low	0.28	5	4L
	7-60	0.6-2.0	0.14-0.19	7.4-8.4	<2	Moderate	Low	Low	0.37		
Barnes	0-7	0.6-2.0	0.13-0.24	6.6-7.3	<2	Low	High	Low	0.28	5	6
	7-12	0.6-2.0	0.15-0.19	6.6-7.8	<2	Low	High	Low	0.28		
	12-60	0.6-2.0	0.14-0.19	7.4-8.4	<2	Low	Moderate	Low	0.37		
913D2**:											
Buse	0-7	0.6-2.0	0.17-0.22	6.6-8.4	<2	Moderate	Low	Low	0.28	5	4L
	7-60	0.6-2.0	0.14-0.19	7.4-8.4	<2	Moderate	Low	Low	0.37		
Barnes	0-8	0.6-2.0	0.13-0.24	6.6-7.3	<2	Low	High	Low	0.28	5	6
	8-20	0.6-2.0	0.15-0.19	6.6-7.8	<2	Low	High	Low	0.28		
	20-60	0.6-2.0	0.14-0.19	7.4-8.4	<2	Low	Moderate	Low	0.37		
915C2**:											
Forman	0-7	0.6-2.0	0.17-0.19	6.6-7.3	<2	Moderate	High	Low	0.28	5	6
	7-14	0.6-2.0	0.15-0.19	6.6-7.8	<2	Moderate	High	Low	0.28		
	14-60	0.2-0.6	0.14-0.19	7.9-8.4	<2	Moderate	Moderate	Low	0.37		
Buse	0-7	0.6-2.0	0.17-0.22	6.6-8.4	<2	Moderate	Low	Low	0.28	5	4L
	7-60	0.2-2.0	0.14-0.19	7.4-8.4	<2	Moderate	Low	Low	0.37		
915D2**:											
Buse	0-7	0.6-2.0	0.17-0.22	6.6-8.4	<2	Moderate	Low	Low	0.28	5	4L
	7-60	0.2-2.0	0.14-0.19	7.4-8.4	<2	Moderate	Low	Low	0.37		
Forman	0-7	0.6-2.0	0.17-0.19	6.6-7.3	<2	Moderate	High	Low	0.28	5	6
	7-14	0.6-2.0	0.15-0.19	6.6-7.8	<2	Moderate	High	Low	0.28		
	14-60	0.2-0.6	0.14-0.19	7.9-8.4	<2	Moderate	Moderate	Low	0.37		

See footnotes at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm						
917D2**:											
Buse	0-7	0.6-2.0	0.17-0.22	6.6-8.4	<2	Moderate	Low	Low	0.28	5	4L
	7-60	0.6-2.0	0.14-0.19	7.4-8.4	<2	Moderate	Low	Low	0.37		
Sioux	0-7	0.6-6.0	0.10-0.20	6.6-8.4	<2	Low	Moderate	Low	0.24	2	8
	7-60	6.0-20	0.03-0.06	7.9-8.4	<2	Low	Low	Low	0.10		
917E**:											
Buse	0-7	0.6-2.0	0.17-0.22	6.6-8.4	<2	Moderate	Low	Low	0.28	5	4L
	7-60	0.6-2.0	0.14-0.19	7.4-8.4	<2	Moderate	Low	Low	0.37		
Sioux	0-7	0.6-6.0	0.10-0.20	6.6-8.4	<2	Low	Moderate	Low	0.24	2	8
	7-60	6.0-20	0.03-0.06	7.9-8.4	<2	Low	Low	Low	0.10		
953C**:											
Arvilla	0-8	2.0-6.0	0.13-0.15	6.6-7.3	<2	Low	Moderate	Low	0.20	3	3
	8-16	2.0-6.0	0.13-0.15	6.6-7.8	<2	Low	Moderate	Low	0.20		
	16-60	>6.0	0.02-0.05	7.4-8.4	<2	Low	Moderate	Low	0.10		
Storden	0-8	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low	Low	Low	0.28	5	4L
	8-60	0.6-2.0	0.17-0.19	7.4-8.4	<2	Low	Low	Low	0.37		
Ves	0-8	0.6-2.0	0.20-0.22	6.1-7.8	<2	Moderate	Moderate	Low	0.24	5	6
	8-18	0.6-2.0	0.17-0.19	6.6-7.8	<2	Moderate	Moderate	Low	0.24		
	18-60	0.6-2.0	0.17-0.19	7.4-8.4	<2	Low	Moderate	Low	0.24		
954C2**, 954D2**:											
Storden	0-8	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low	Low	Low	0.28	5	4L
	8-60	0.6-2.0	0.17-0.19	7.4-8.4	<2	Low	Low	Low	0.37		
Ves	0-8	0.6-2.0	0.20-0.22	6.1-7.8	<2	Moderate	Moderate	Low	0.24	5	6
	8-18	0.6-2.0	0.17-0.19	6.6-7.8	<2	Moderate	Moderate	Low	0.24		
	18-60	0.6-2.0	0.17-0.19	7.4-8.4	<2	Low	Moderate	Low	0.24		
986**:											
Lamoure	0-25	0.6-2.0	0.19-0.22	7.4-8.4	<4	Moderate	High	Moderate	0.28	5	4L
	25-38	0.6-2.0	0.17-0.20	7.4-8.4	<4	Moderate	High	Moderate	0.28		
	38-60	0.6-2.0	0.09-0.18	7.4-8.4	<4	Low	High	Moderate	0.28		
La Prairie	0-40	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	Moderate	Low	0.28	5	6
	40-60	0.6-2.0	0.15-0.20	7.4-8.4	<2	Moderate	Moderate	Low	0.28		
1016**: Udorthents											
1029**. Pits, gravel											
1032**. Aquents and Udorthents											
1053**. Aquolls and Aquents											
1809** Bearden	0-14	0.2-0.6	0.17-0.23	7.4-8.4	<4	Moderate	High	Low	0.28	5	4L
	14-37	0.2-2.0	0.16-0.22	7.4-8.4	<8	Moderate	High	Low	0.28		
	37-60	0.6-2.0	0.16-0.22	7.4-8.4	<8	Moderate	High	Low	0.43		
1810** Colvin	0-14	0.2-0.6	0.20-0.22	7.4-9.0	<2	High	High	Low	0.32	5	4L
	14-60	0.2-2.0	0.16-0.20	7.4-9.0	<2	High	High	Low*	0.32		
1814 Oldham	0-33	0.06-0.2	0.13-0.19	6.6-7.8	<2	High	High	Moderate	0.28	5	4L
	33-60	0.06-0.6	0.14-0.20	7.4-8.4	<2	Moderate	High	Moderate	0.43		

* Moderate in areas where the soil is high in content of sulfates.
**See map unit description for the composition and behavior of the map unit.

TABLE 15.--SOIL AND WATER FEATURES

[Absence of an entry indicates the feature is not a concern. See text for descriptions of symbols and such terms as "rare," "brief," and "perched." The symbol < means less than; > means greater than]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action
		Frequency	Duration	Months	Depth	Kind	Months	
					Ft			
6: Aastad	B	None	---	---	3.0-6.0	Apparent	Mar-Jun	Moderate.
33B, 33B2: Barnes	B	None	---	---	>6.0	---	---	Moderate.
36: Flom	B/D	Rare	---	---	1.0-3.0	Apparent	Nov-Jun	High.
51: La Prairie	B	Occasional	Brief	Mar-Jun	3.0-6.0	Apparent	Mar-Jun	Moderate.
70: Svea	B	None	---	---	4.0-6.0	Apparent	Apr-Jun	Moderate.
86: Canisteo	C/D	None	---	---	1.0-3.0	Apparent	Nov-Jun	High.
114: Glencoe	B/D	Frequent	Brief to long.	Apr-May	0-1.0	Apparent	Oct-Jun	High.
127, 127B: Sverdrup	B	None	---	---	>6.0	---	---	Low.
149B, 149B2, 149C2: Everly	B	None	---	---	>6.0	---	---	Moderate.
168B, 168B2: Forman	B	None	---	---	>6.0	---	---	Moderate.
184: Hamerly	C	None	---	---	3.0-5.0	Apparent	Sep-Jun	High.
210: Fulda	C/D	Rare	---	---	1.0-3.0	Apparent	Mar-Jun	High.
212: Sinai	C	None	---	---	>6.0	---	---	Low.
219: Rolfe	C	Common	Brief	Mar-Jun	0-3.0	Apparent	Mar-Jun	High.
236: Vallers	C	Rare	---	---	1.0-3.0	Apparent	Nov-Jun	High.
241: Letri	B/D	Rare	---	---	0-2.0	Perched	Apr-Jun	High.
246: Marysland	B/D	Occasional	Brief	Apr-Nov	1.0-3.0	Apparent	Nov-Jul	High.
276: Oldham	C/D	Frequent	Brief to long.	Apr-Oct	0-1.0	Apparent	Oct-Jun	High.
284B, 284B2, 284C2: Poinsett	B	None	---	---	>6.0	---	---	High.
335: Urness	B/D	Frequent	Long	Apr-Nov	0-1.0	Apparent	Jan-Dec	High.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action
		Frequency	Duration	Months	Depth	Kind	Months	
					Ft			
339, 339B--------- Fordville	B	None---------	---	---	>6.0	---	---	Low.
341, 341B, 341C--- Arvilla	A	None---------	---	---	>6.0	---	---	Low.
344--------------- Quam	B/D	Frequent----	Long--------	Apr-Nov	0-1.0	Apparent	Jan-Dec	High.
345--------------- Wilmonton	B	None---------	---	---	3.0-6.0	Apparent	Mar-Jun	High.
347--------------- Malachy	B	None---------	---	---	3.0-5.0	Apparent	Nov-Apr	High.
402E-------------- Sioux	A	None---------	---	---	>6.0	---	---	Low.
418--------------- Lamoure	C	Frequent----	Brief-------	Mar-Oct	1.0-3.0	Apparent	Oct-Jun	High.
421B, 421B2------- Ves	B	None---------	---	---	>6.0	---	---	Moderate.
423--------------- Seaforth	B	None---------	---	---	3.0-5.0	Apparent	Mar-Jun	High.
437E, 437F-------- Buse	B	None---------	---	---	>6.0	---	---	Moderate.
446--------------- Normania	B	None---------	---	---	3.0-6.0	Apparent	Mar-Jun	High.
450--------------- Rauville	D	Frequent----	Brief-------	Mar-Oct	0-1.0	Apparent	Jan-Dec	High.
494B-------------- Darnen	B	None---------	---	---	>6.0	---	---	Moderate.
894D2*:								
Storden----------	B	None---------	---	---	>6.0	---	---	Moderate.
Everly-----------	B	None---------	---	---	>6.0	---	---	Moderate.
902C2*:								
Barnes-----------	B	None---------	---	---	>6.0	---	---	Moderate.
Buse-------------	B	None---------	---	---	>6.0	---	---	Moderate.
904B2*:								
Arvilla----------	A	None---------	---	---	>6.0	---	---	Low.
Barnes-----------	B	None---------	---	---	>6.0	---	---	Moderate.
Buse-------------	B	None---------	---	---	>6.0	---	---	Moderate.
904C2*:								
Arvilla----------	A	None---------	---	---	>6.0	---	---	Low.
Buse-------------	B	None---------	---	---	>6.0	---	---	Moderate.
Barnes-----------	B	None---------	---	---	>6.0	---	---	Moderate.
913D2*:								
Buse-------------	B	None---------	---	---	>6.0	---	---	Moderate.
Barnes-----------	B	None---------	---	---	>6.0	---	---	Moderate.

See footnote at end of table.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action
		Frequency	Duration	Months	Depth	Kind	Months	
					Ft			
915C2*:								
Forman	B	None	---	---	>6.0	---	---	Moderate.
Buse	B	None	---	---	>6.0	---	---	Moderate.
915D2*:								
Buse	B	None	---	---	>6.0	---	---	Moderate.
Forman	B	None	---	---	>6.0	---	---	Moderate.
917D2*, 917E*:								
Buse	B	None	---	---	>6.0	---	---	Moderate.
Sioux	A	None	---	---	>6.0	---	---	Low.
953C*:								
Arvilla	A	None	---	---	>6.0	---	---	Low.
Storden	B	None	---	---	>6.0	---	---	Moderate.
Ves	B	None	---	---	>6.0	---	---	Moderate.
954C2*, 954D2*:								
Storden	B	None	---	---	>6.0	---	---	Moderate.
Ves	B	None	---	---	>6.0	---	---	Moderate.
986*:								
Lamoure	C	Frequent	Brief	Mar-Oct	1.0-3.0	Apparent	Oct-Jun	High.
La Prairie	B	Frequent	Brief	Mar-Jun	3.0-6.0	Apparent	Mar-Jun	Moderate.
1016*. Udorthents								
1029*. Pits, gravel								
1032*. Aquents and Udorthents								
1053*. Aquolls and Aquents								
1809* Bearden	C	None	---	---	3.0-5.0	Apparent	Sep-Jun	High.
1810* Colvin	C/D	None to common.	Long	Apr-Jun	1.0-3.0	Apparent	Apr-Jun	High.
1814 Oldham	C/D	Occasional	Brief to long.	Apr-Oct	1.0-3.0	Apparent	Oct-Jun	High.

* See map unit description for the composition and behavior of the map unit.

TABLE 16.--ENGINEERING TEST DATA

Soil name, report number, horizon, and depth in inches	Classification		Grain size distribution							Liquid limit	Plasticity index	Moisture density	
			Percentage passing sieve				Percentage smaller than--						
	AASHTO	Unified	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm			Maximum density	Optimum moisture
										Pct		Lb/ft3	Pct
Aastad clay loam (SS7383-4-5)													
Ap------ 0 to 9	A-7-6	OL	99	98	90	67.3	49	35	27	50	23	95.4	23.7
B2------ 12 to 19	A-7-6	CL	99	96	88	65.9	50	37	27	45	22	102.9	20.6
C------- 28 to 60	A-6	CL	98	96	88	68.5	52	39	26	40	21	106.4	18.0
Arvilla sandy loam (SS7377-8-9)													
A1------ 0 to 9	A-4	SM	99	97	72	38.3	23	14	10	30	10	108.4	17.7
B2------ 9 to 14	A-4	SM-SC	98	92	59	36.9	26	15	8	30	10	115.0	13.8
IIC1---- 19 to 60	A-1-6	SP-SM	77	62	24	10.8	10	7	6	---	NP	127.4	10.4
Barnes loam (SS7368-9-70)													
Ap------ 0 to 6	A-6	CL	99	98	89	65.9	44	32	24	38	12	100.8	20.6
B2------ 11 to 16	A-6	CL	99	97	88	68.2	43	32	28	37	14	105.1	18.1
C3------ 42 to 63	A-6	CL	96	93	81	55.4	36	28	21	29	11	117.4	14.0
Canisteo clay loam (SS7360-1-2)													
Ap------ 0 to 9	A-7-6	CL	100	100	95	69.8	45	33	24	49	20	91.8	23.9
B2g----- 22 to 31	A-7-6	CL	98	96	88	65.2	48	37	29	42	24	102.1	20.9
C2g----- 39 to 60	A-6	CL	99	96	86	60.4	35	26	20	34	15	109.6	17.6
Colvin clay loam (SS7371-2-3)													
Ap------ 0 to 9	A-7-6	CL	98	95	91	75.8	50	35	25	50	24	96.3	23.4
B21----- 14 to 25	A-7-6	CL	100	100	99	89.5	51	35	24	44	20	98.3	22.7
Cg------ 44 to 60	A-7-6	CH	100	100	100	95.7	84	65	49	64	35	90.2	29.1
Glencoe silty clay loam (SS7374-5-6)													
A12----- 10 to 17	A-7-6	OH	100	100	99	96.5	69	45	37	53	24	87.4	28.4
Ag3----- 30 to 42	A-7-6	CL	100	100	98	95.7	63	43	33	48	25	98.1	22.2
C1g----- 47 to 60	A-7-6	CL	100	99	97	89.9	70	45	36	50	25	93.1	26.9
Lamoure silty clay loam (SS7386-7-8)													
A12----- 10 to 17	A-7-6	CH	100	100	99	90.0	68	47	35	56	29	89.5	28.7
B2g----- 25 to 38	A-7-6	CL	100	100	99	84.6	61	45	37	50	28	96.0	24.1
C2g----- 43 to 60	A-7-6	CL	100	100	100	87.1	62	48	37	48	28	102.6	21.1
Ves loam (SS7389-90-1)													
Ap------ 0 to 8	A-6	CL	100	99	94	69.7	48	32	23	40	15	97.4	21.4
B2------ 24 to 34	A-6	CL	99	98	92	65.0	51	36	25	40	19	97.1	21.2
C2------ 49 to 57	A-6	CL	99	96	89	67.9	52	33	21	37	15	100.4	21.7

TABLE 17.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates a taxadjunct to the series. See text for a description of those characteristics of this taxadjunct that are outside the range of the series]

Soil name	Family or higher taxonomic class
Aastad	Fine-loamy, mixed Pachic Udic Haploborolls
Aquents and Udorthents	Sandy and loamy, mixed, nonacid Aquents and Udorthents
Aquolls and Aquents	Loamy, mixed, nonacid Aquolls and Aquents
Arvilla	Sandy, mixed Udic Haploborolls
*Barnes	Fine-loamy, mixed Udic Haploborolls
*Bearden	Fine-silty, frigid Aeric Calciaquolls
Buse	Fine-loamy, mixed Udorthentic Haploborolls
Canisteo	Fine-loamy, mixed (calcareous), mesic Typic Haplaquolls
*Colvin	Fine-silty, frigid Typic Calciaquolls
Darnen	Fine-loamy, mixed Pachic Udic Haploborolls
*Everly	Fine-loamy, mixed, mesic Typic Hapludolls
Flom	Fine-loamy, mixed, frigid Typic Haplaquolls
Fordville	Fine-loamy over sandy or sandy-skeletal, mixed Pachic Udic Haploborolls
*Forman	Fine-loamy, mixed Udic Argiborolls
Fulda	Fine, montmorillonitic, frigid Typic Haplaquolls
Glencoe	Fine-loamy, mixed, mesic Cumulic Haplaquolls
*Hamerly	Fine-loamy, frigid Aeric Calciaquolls
La Prairie	Fine-loamy, mixed Cumulic Udic Haploborolls
Lamoure	Fine-silty, mixed (calcareous), frigid Cumulic Haplaquolls
Letri	Fine-loamy, mixed, mesic Typic Haplaquolls
*Malachy	Coarse-loamy, mixed Pachic Udic Haploborolls
*Marysland	Fine-loamy over sandy or sandy-skeletal, frigid Typic Calciaquolls
Normania	Fine-loamy, mixed, mesic Aquic Haplustolls
Oldham	Fine, montmorillonitic (calcareous), frigid Cumulic Haplaquolls
*Poinsett	Fine-silty, mixed Udic Haploborolls
Quam	Fine-silty, mixed, frigid Cumulic Haplaquolls
Rauville	Fine-silty, mixed (calcareous), frigid Cumulic Haplaquolls
Rolfe	Fine, montmorillonitic, mesic Typic Argialbolls
Seaforth	Fine-loamy, mixed, mesic Aquic Calciustolls
Sinai	Fine, montmorillonitic Pachic Udic Haploborolls
Sioux	Sandy-skeletal, mixed Udorthentic Haploborolls
Storden	Fine-loamy, mixed (calcareous), mesic Typic Udorthents
Svea	Fine-loamy, mixed Pachic Udic Haploborolls
Sverdrup	Sandy, mixed Udic Haploborolls
Udorthents	Loamy, mixed, nonacid Udorthents
Urness	Fine-silty, mixed (calcareous), frigid Mollic Fluvaquents
Vallers	Fine-loamy, frigid Typic Calciaquolls
Ves	Fine-loamy, mixed, mesic Udic Haplustolls
Wilmonton	Fine-loamy, mixed, mesic Aquic Hapludolls

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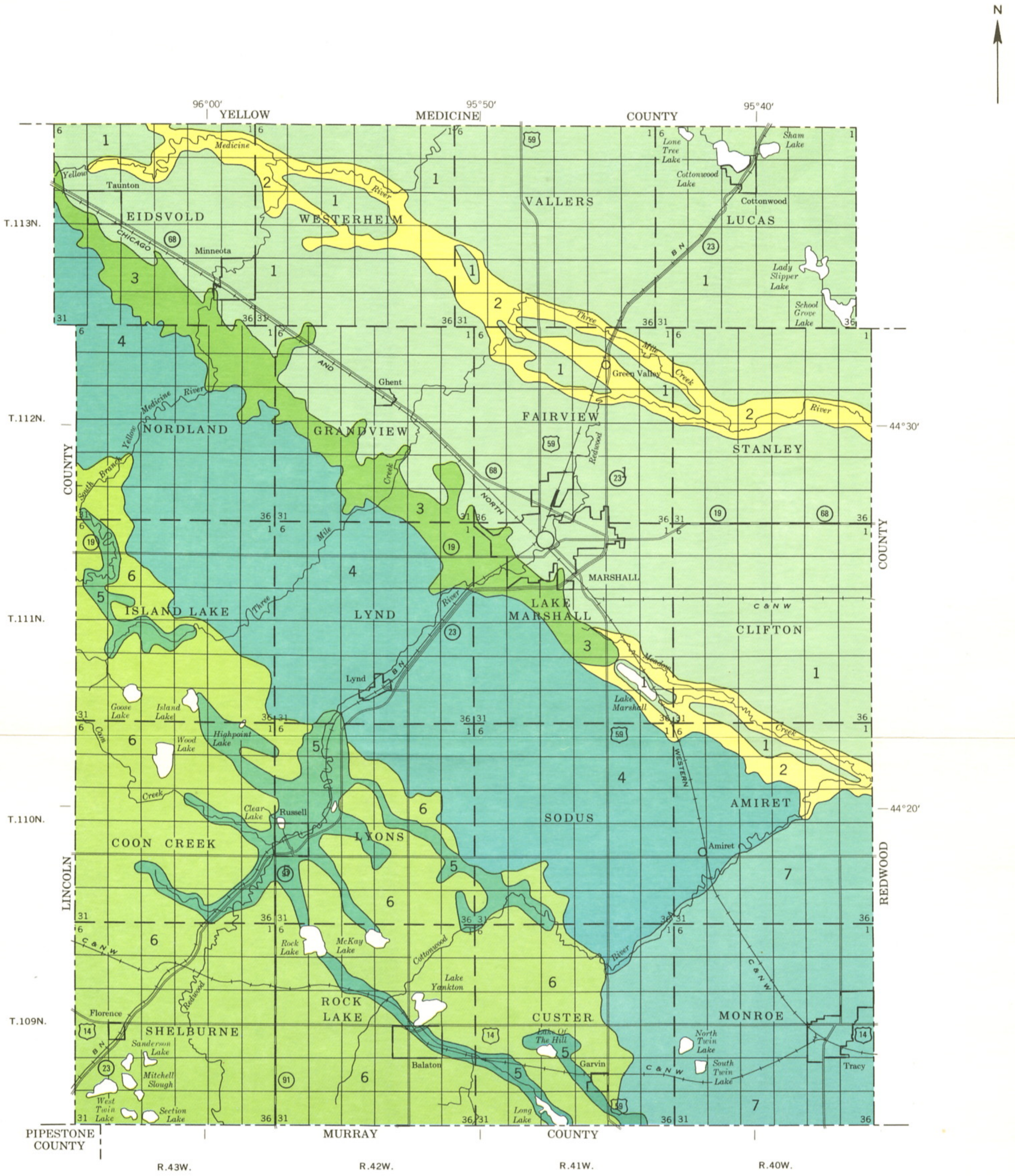


SOIL LEGEND

1	Ves-Canisteo: Well drained and poorly drained, undulating and nearly level soils that formed in shaly glacial till
2	Lamoure-La Prairie: Poorly drained and moderately well drained, nearly level soils that formed in alluvial material
3	Colvin-Bearden: Poorly drained and somewhat poorly drained, nearly level soils that formed in lacustrine and alluvial sediments
4	Forman-Aastad: Well drained and moderately well drained, undulating and nearly level soils that formed in glacial till
5	Arvilla-Barnes-Buse: Somewhat excessively drained and well drained, nearly level to moderately steep soils that formed in glacial outwash, drift, and till
6	Barnes-Flom-Buse: Well drained and poorly drained, nearly level to moderately steep soils that formed in glacial till
7	Everly-Letri-Wilmonton: Well drained, poorly drained, and moderately well drained, nearly level to rolling soils that formed in glacial till

Compiled 1977

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

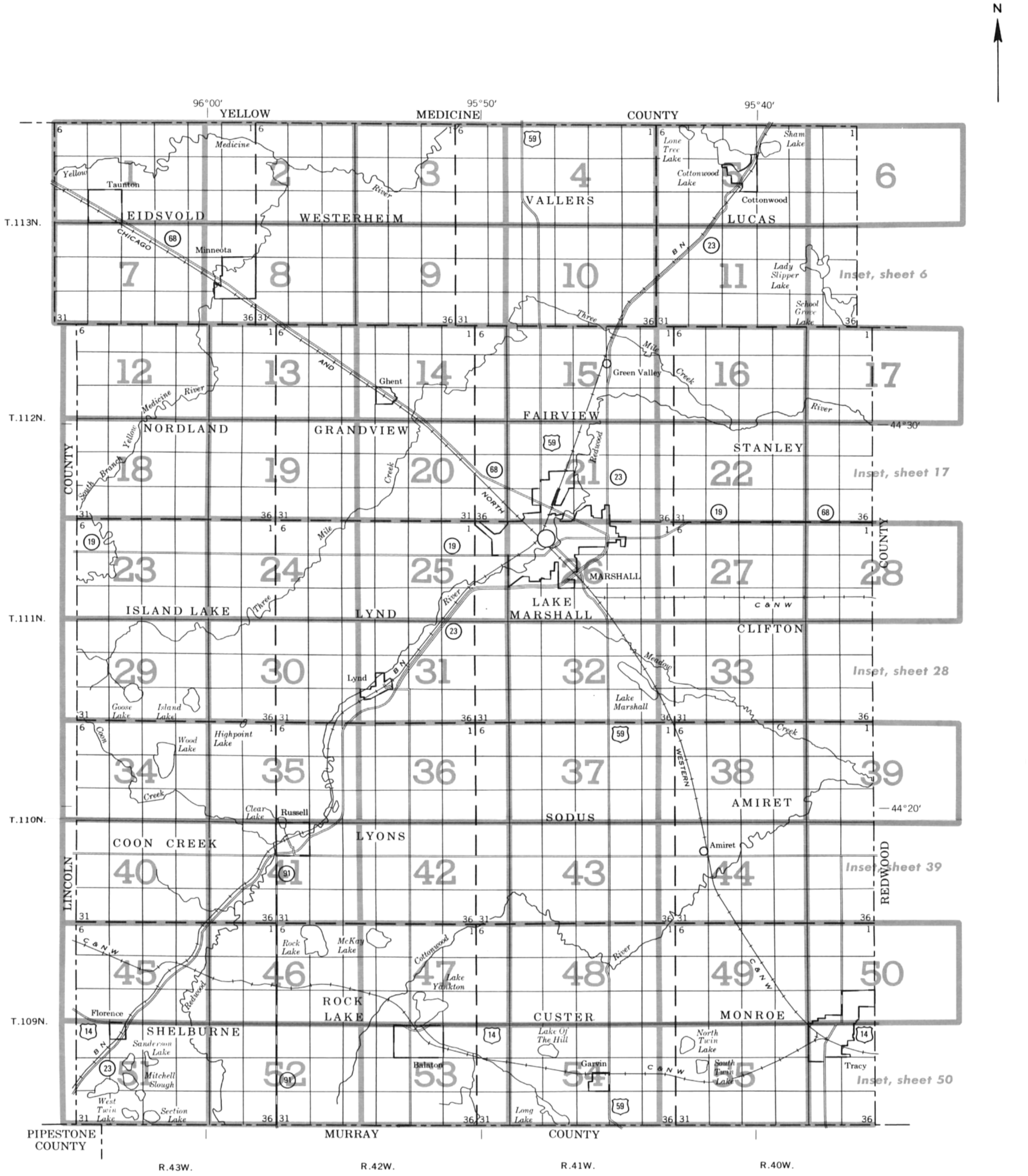
UNIVERSITY OF MINNESOTA AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

LYON COUNTY, MINNESOTA

Scale 1:190,080

1 0 1 2 3 4 Miles



INDEX TO MAP SHEETS

LYON COUNTY, MINNESOTA

Scale 1:190,080

1 0 1 2 3 4 Miles

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

SOIL LEGEND

Symbols consist of numbers or a combination of numbers and letters, for example 6, 33B, 341 and 915C2. The 1, 2, 3 or 4 digit numbers designate the kind of soil or miscellaneous area. A capital letter B, C, D, E or F following a number, indicates the class of slope. Most symbols without a slope letter are those for nearly level soils or they are for miscellaneous areas. A final number 2 following a letter indicates that the soil is eroded.

SYMBOL	NAME
6	Aastad clay loam, 0 to 2 percent slopes
33B	Barnes loam, 1 to 4 percent slopes
33B2	Barnes loam, 3 to 6 percent slopes, eroded
36	Flom clay loam
51	La Prairie loam
70	Svea loam, 1 to 3 percent slopes
86	Canisteo clay loam
114	Glencoe silty clay loam
127	Sverdrup sandy loam, 0 to 2 percent slopes
127B	Sverdrup sandy loam, 2 to 6 percent slopes
149B	Everly clay loam, 2 to 4 percent slopes
149B2	Everly clay loam, 3 to 6 percent slopes, eroded
149C2	Everly clay loam, 6 to 12 percent slopes, eroded
168B	Forman clay loam, 2 to 4 percent slopes
168B2	Forman clay loam, 3 to 6 percent slopes, eroded
184	Hamerly loam, 1 to 3 percent slopes
210	Fulda silty clay
212	Sinai silty clay, 1 to 3 percent slopes
219	Rolfe loam
236	Vallers clay loam
241	Letri clay loam
246	Marysland loam
276	Oldham silty clay loam
284B	Poinsett silty clay loam, 1 to 4 percent slopes
284B2	Poinsett silty clay loam, 3 to 6 percent slopes, eroded
284C2	Poinsett silty clay loam, 6 to 12 percent slopes, eroded
335	Umess silt loam
339	Fordville loam, 0 to 2 percent slopes
339B	Fordville loam, 2 to 6 percent slopes
341	Arvilla sandy loam, 0 to 2 percent slopes
341B	Arvilla sandy loam, 2 to 6 percent slopes
341C	Arvilla sandy loam, 6 to 12 percent slopes
344	Quam silty clay loam
345	Wilmonton clay loam, 0 to 2 percent slopes
347	Malachy loam
402E	Sioux soils, 2 to 40 percent slopes
418	Lamoure silty clay loam
421B	Ves loam, 1 to 4 percent slopes
421B2	Ves loam, 3 to 6 percent slopes, eroded
423	Seaforth loam, 1 to 3 percent slopes
437E	Buse loam, 18 to 25 percent slopes
437F	Buse loam, 25 to 40 percent slopes
446	Normania loam, 1 to 3 percent slopes
450	Rauville silty clay loam
494B	Darnen loam, 2 to 6 percent slopes
894D2	Storden-Everly complex, 12 to 18 percent slopes, eroded
902C2	Barnes-Buse loams, 6 to 12 percent slopes, eroded
904B2	Arvilla-Barnes-Buse complex, 2 to 6 percent slopes, eroded
904C2	Arvilla-Buse-Barnes complex, 6 to 12 percent slopes, eroded
913D2	Buse-Barnes loams, 12 to 18 percent slopes, eroded
915C2	Forman-Buse complex, 6 to 12 percent slopes, eroded
915D2	Buse-Forman complex, 12 to 18 percent slopes, eroded
917D2	Buse-Sioux complex, 12 to 18 percent slopes, eroded
917E	Buse-Sioux complex, 18 to 40 percent slopes
953C	Arvilla-Storden-Ves complex, 6 to 15 percent slopes
954C2	Storden-Ves loams, 5 to 12 percent slopes, eroded
954D2	Storden-Ves loams, 12 to 18 percent slopes, eroded
986	Lamoure and La Prairie soils, frequently flooded
1016	Udorthents
1029	Pits, gravel
1032	Aquents and Udorthents
1053	Aquolls and Aquents, ponded
1809	Bearden complex
1810	Colvin complex
1814	Oldham silty clay

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool — Davis Airstrip; FLOOD POOL LINE

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate — 79
- Federal — 410
- State — 52
- County, farm or ranch — 378

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small — water; w

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) — Indian Mound
- Located object (label) — Tower
- Tank (label) — GAS
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) — CANAL
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial — water; w
- Intermittent — int; i

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — 6; 33B

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

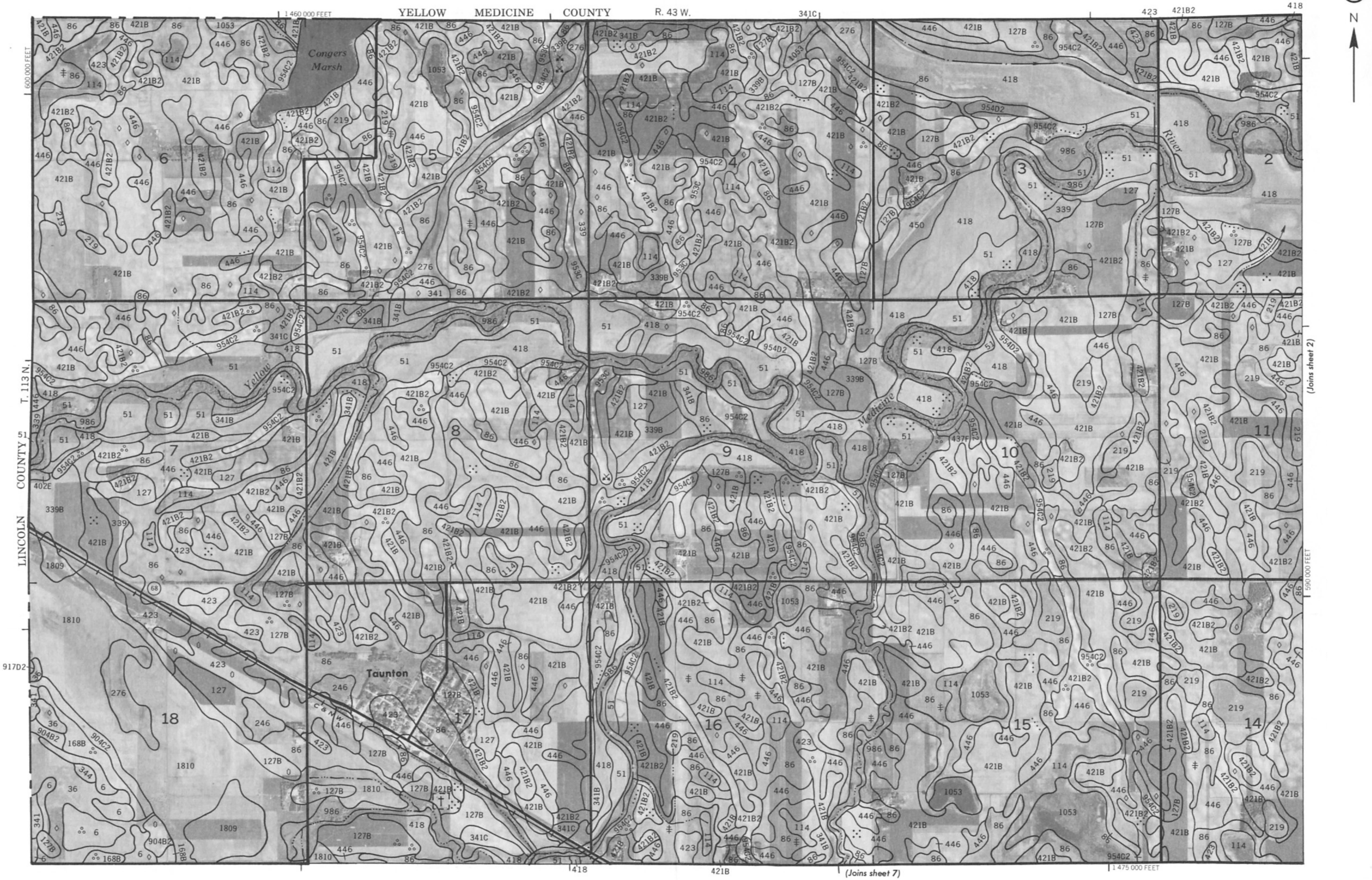
GULLY

DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown) — S

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Area of high lime soils up to two acres in size
- Area of better drained soils up to two acres in size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YELLOW MEDICINE COUNTY
R. 43 W.
1 460 000 FEET
600 000 FEET
T. 113 N.
LINCOLN COUNTY
Congers Marsh
Yellow
Medicine
River
Taunton
C & N W
(Joins sheet 2)
(Joins sheet 7)
590 000 FEET
1 475 000 FEET
1
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14
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16
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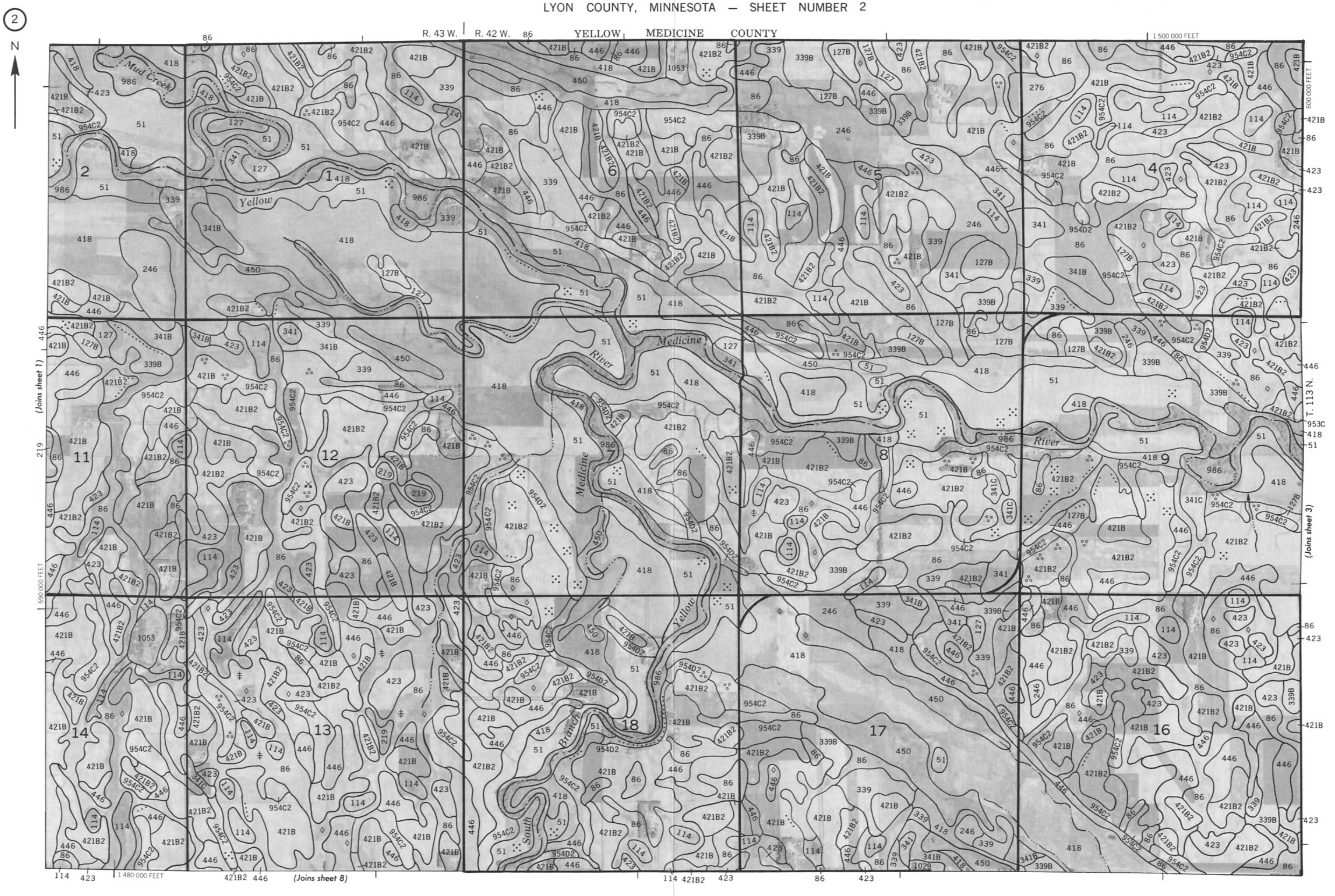
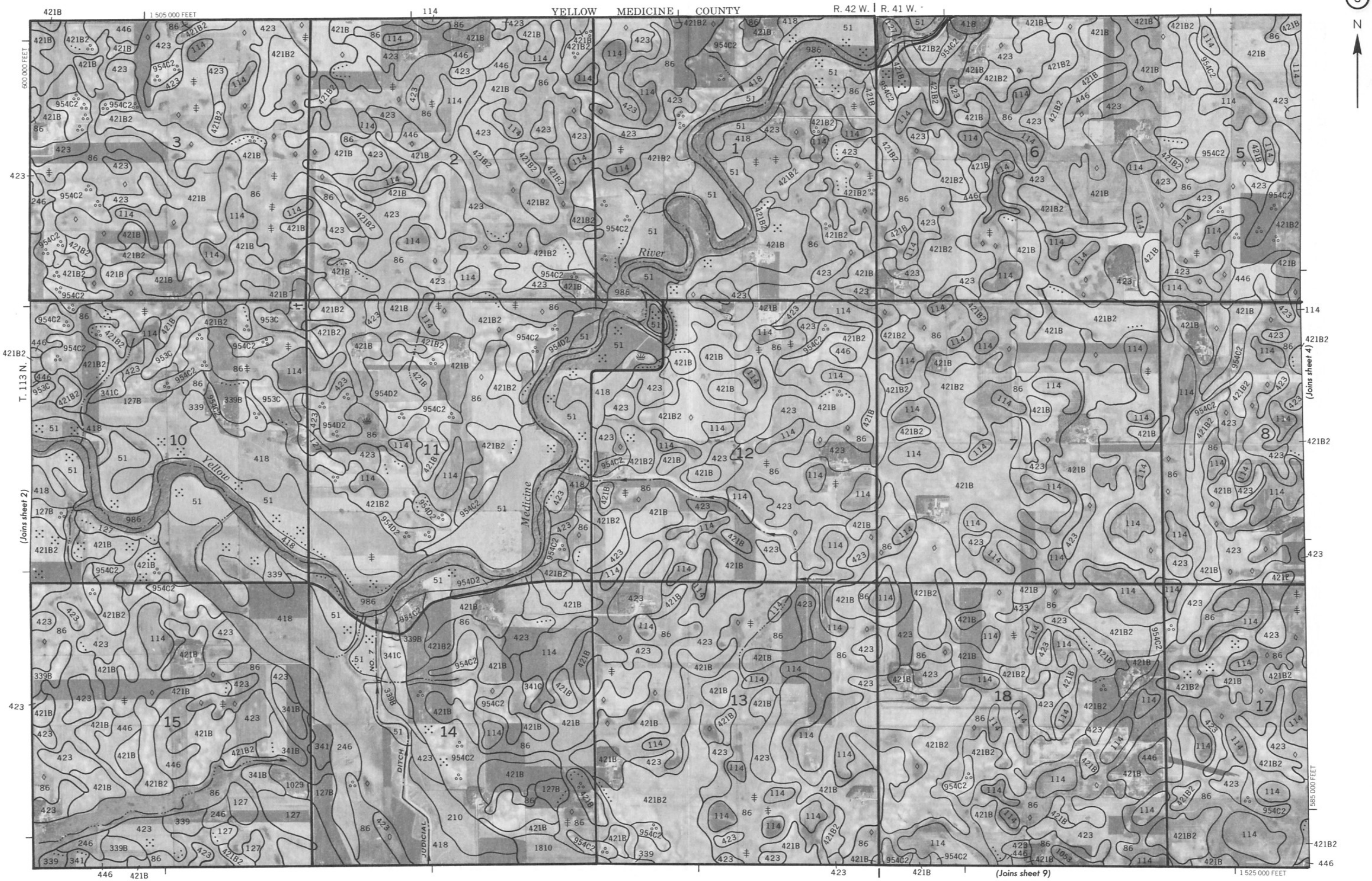
18

LYON COUNTY, MINNESOTA — SHEET NUMBER 2




YELLOW MEDICINE COUNTY
R. 42 W.
R. 41 W.
T. 113 N.
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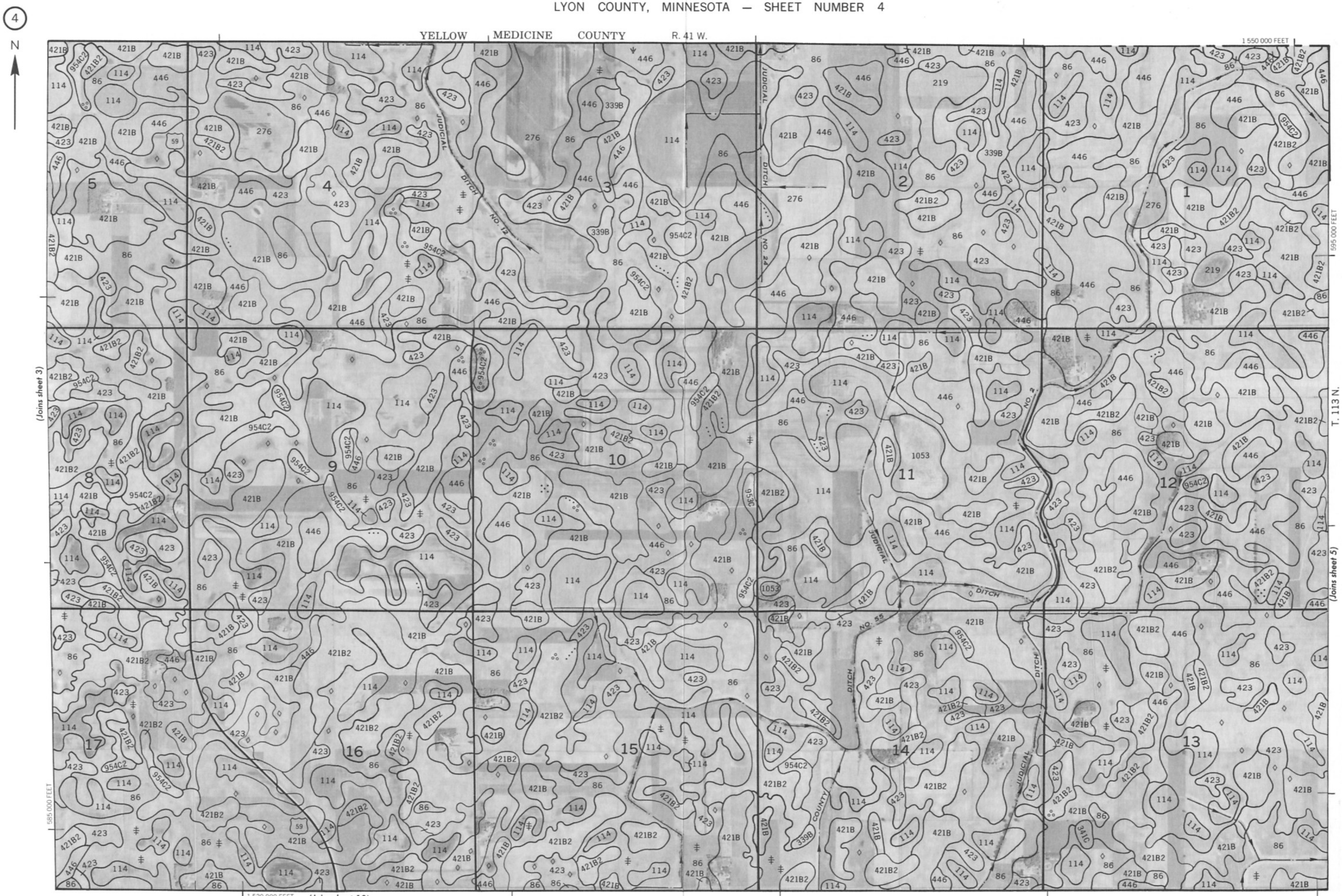
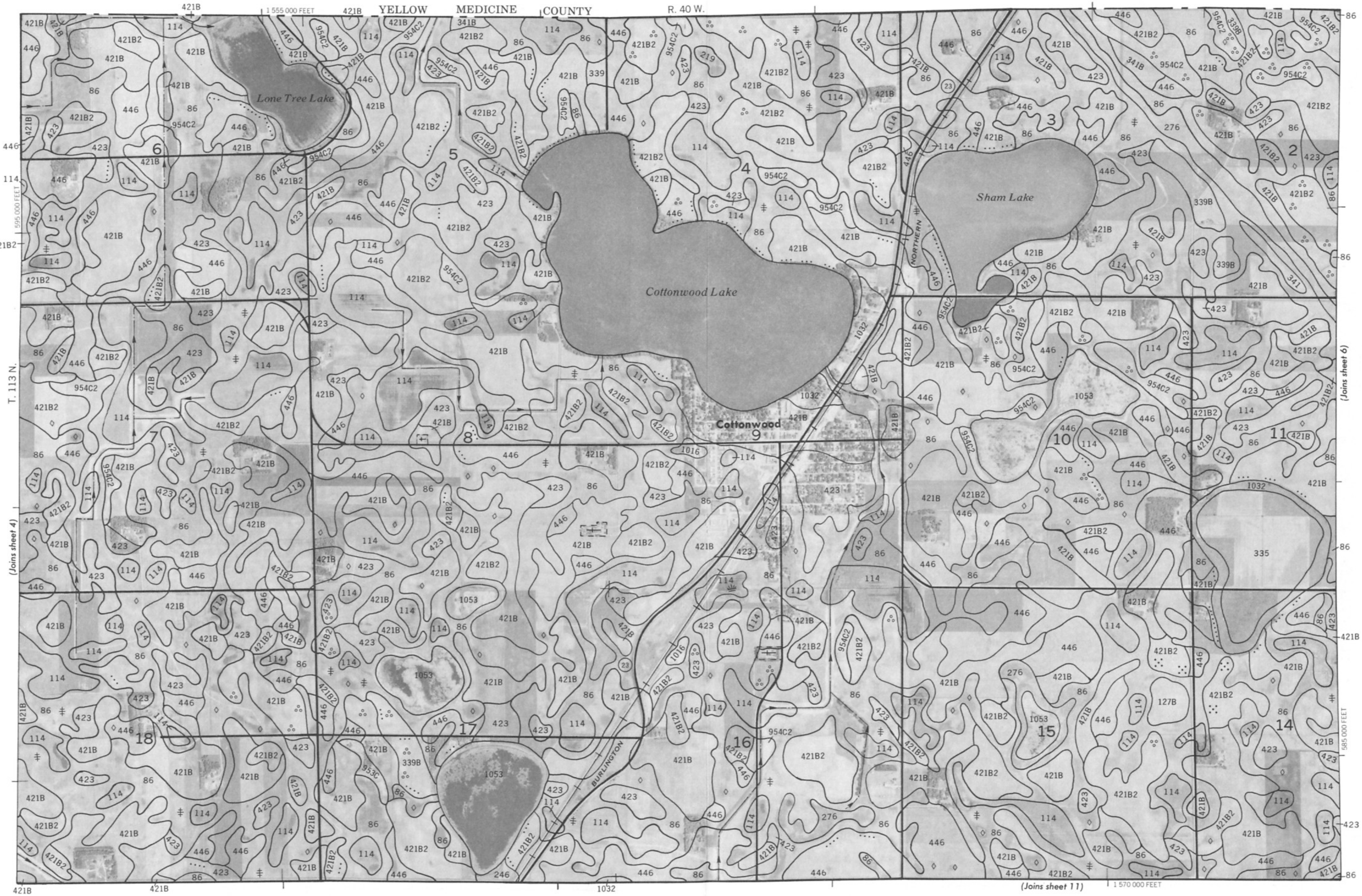
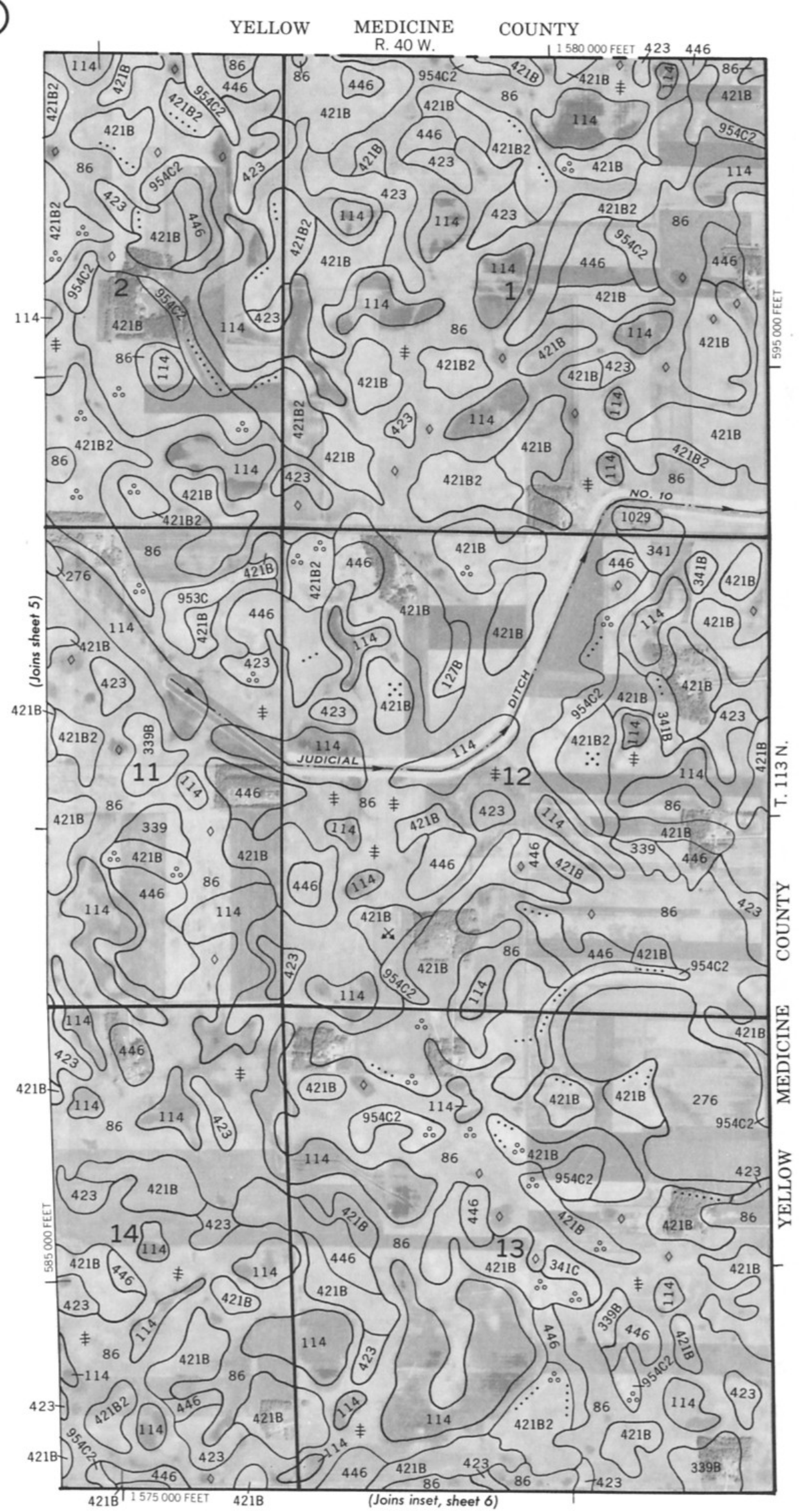
600 000 FEET
585 000 FEET
1 525 000 FEET
(Joins sheet 2)
(Joins sheet 4)
(Joins sheet 9)
Yellow
Medicine
River
NO. 7
JUDICIAL
DITCH
N

LYON COUNTY, MINNESOTA — SHEET NUMBER 4




YELLOW MEDICINE COUNTY
R. 40 W.
1 555 000 FEET
N
Lone Tree Lake
Cottonwood Lake
Sham Lake
Cottonwood
NORTHERN
BURLINGTON
T. 113 N.
595 000 FEET
585 000 FEET
1 570 000 FEET
(Joins sheet 4)
(Joins sheet 6)
(Joins sheet 11)

6


N
YELLOW MEDICINE COUNTY
R. 40 W.
1 580 000 FEET
595 000 FEET
T. 113 N.
YELLOW MEDICINE COUNTY
585 000 FEET
1 575 000 FEET
(Joins sheet 5)
(Joins inset, sheet 6)
NO. 10
JUDICIAL DITCH
2
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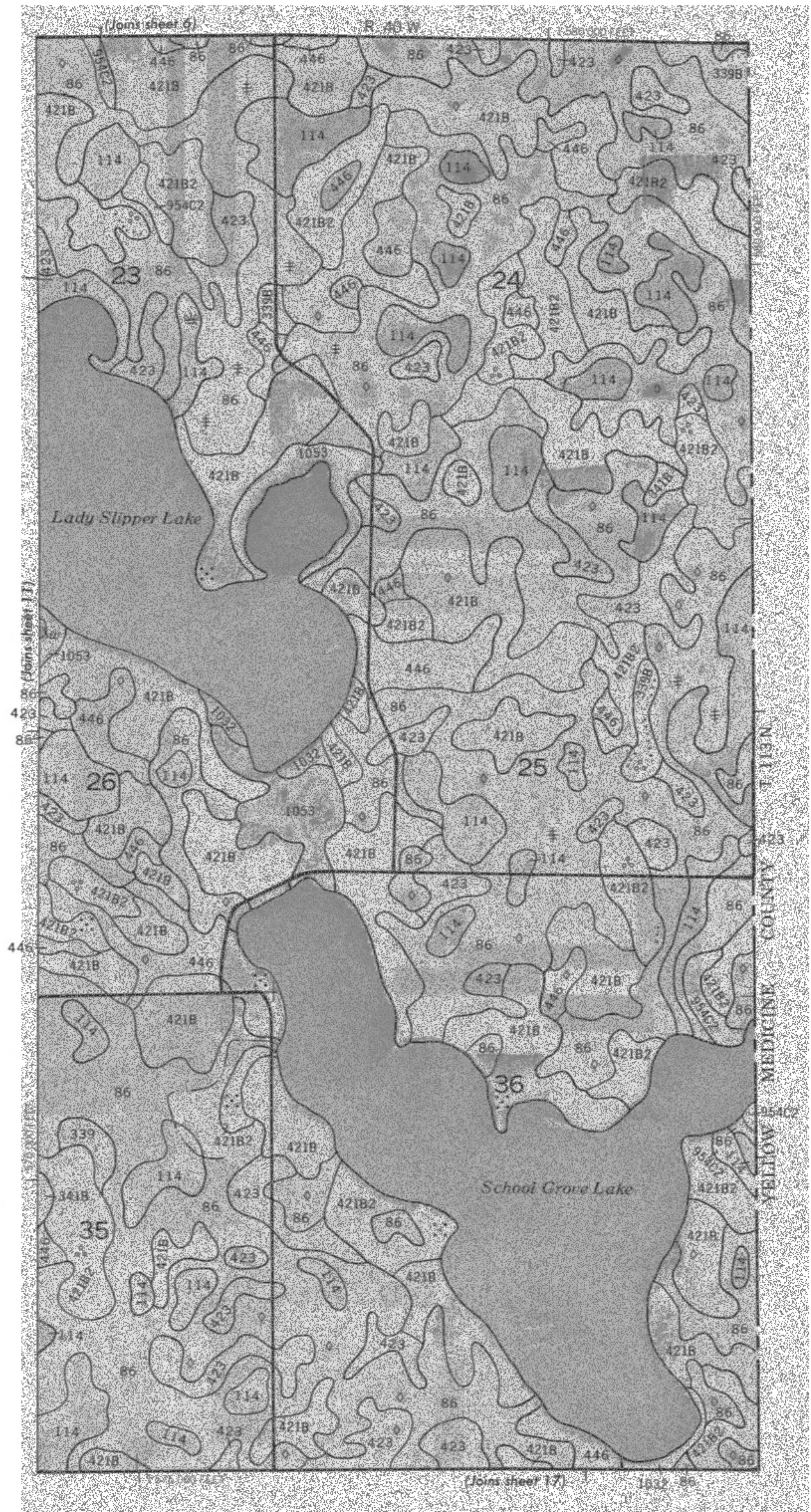
14
13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R. 40 W.
(Joins sheet 11)
(Joins sheet 17)
T. 113 N.
YELLOW MEDICINE COUNTY
Lady Slipper Lake
School Grove Lake
23
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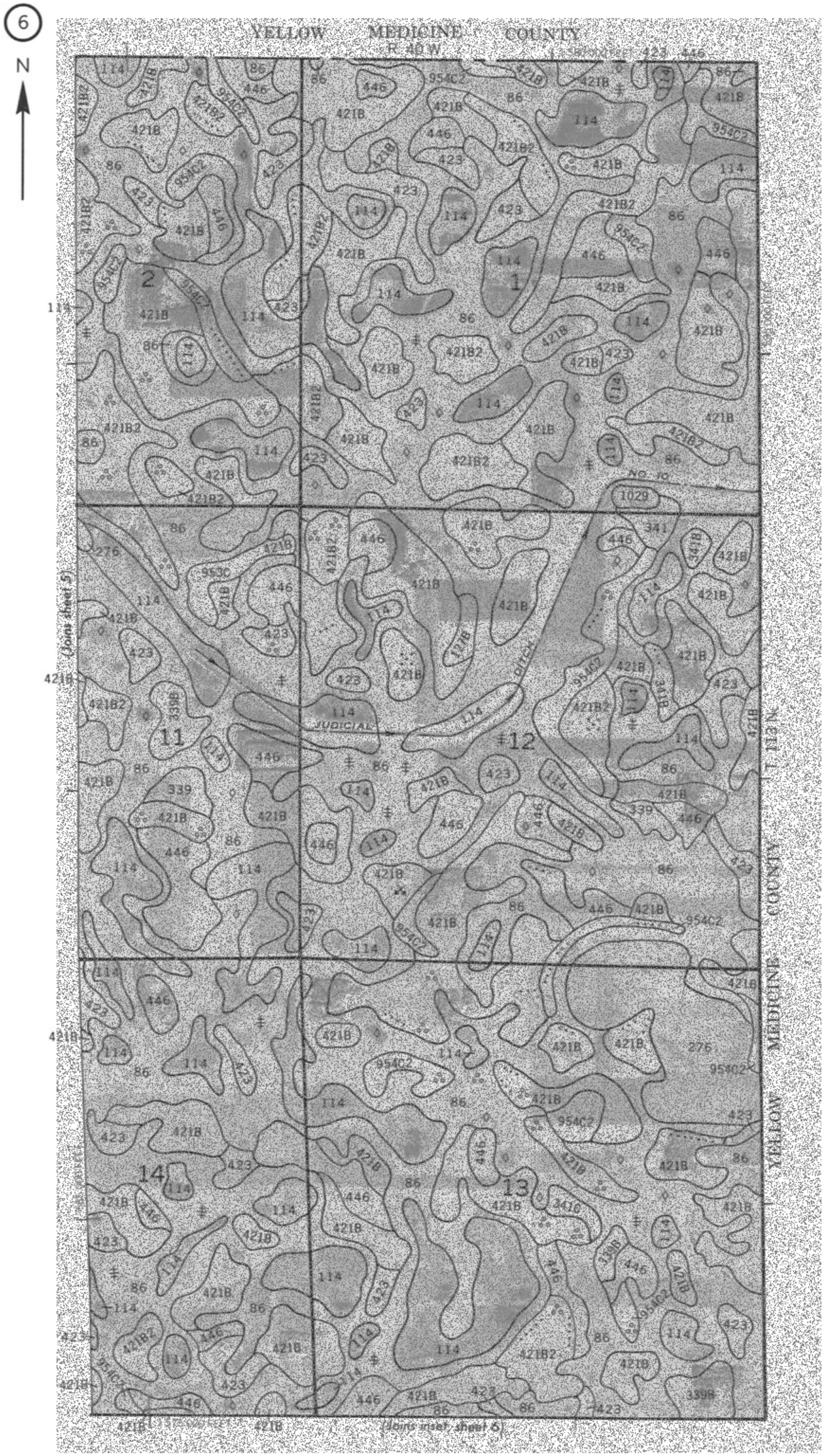
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N
YELLOW MEDICINE COUNTY
R. 40 W.
(Joins sheet 5)
JUDICIAL
DITCH
NO. 10
T. 113 N.
YELLOW MEDICINE COUNTY
(Joins inset, sheet 6)
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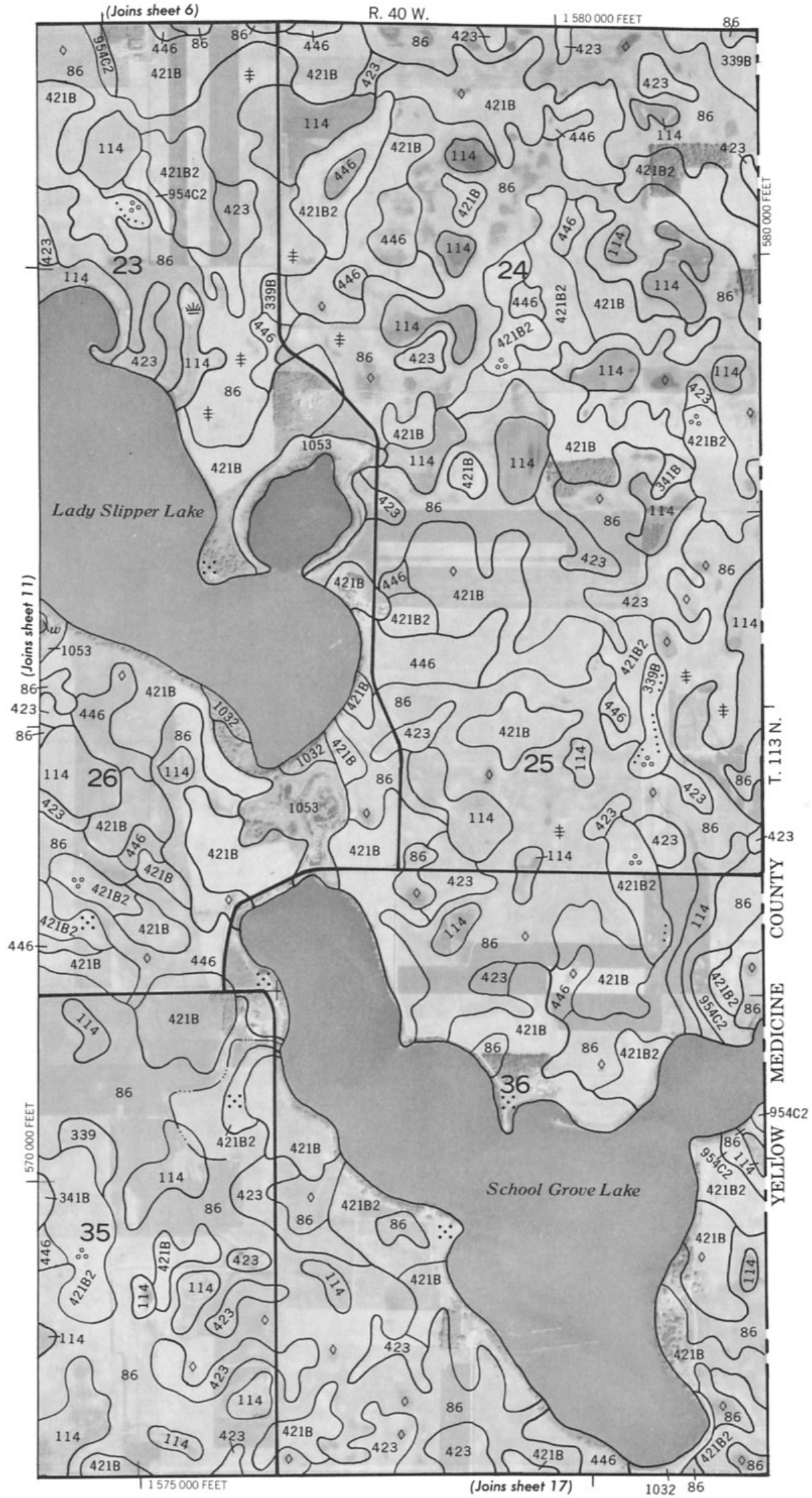
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R. 40 W.
1 580 000 FEET
580 000 FEET
Lady Slipper Lake
(Joins sheet 11)
School Grove Lake
T. 113 N.
YELLOW MEDICINE COUNTY
570 000 FEET
1 575 000 FEET
(Joins sheet 17)
23
24
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26
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36


7
N
1 455 000 FEET
585 000 FEET
R. 43 W.
(Joins sheet 1)
(Joins sheet 8)
(Joins sheet 12)
T. 113 N.
LINCOLN COUNTY
LINCOLN
COUNTY
CHICAGO AND NORTH WESTERN
19
20
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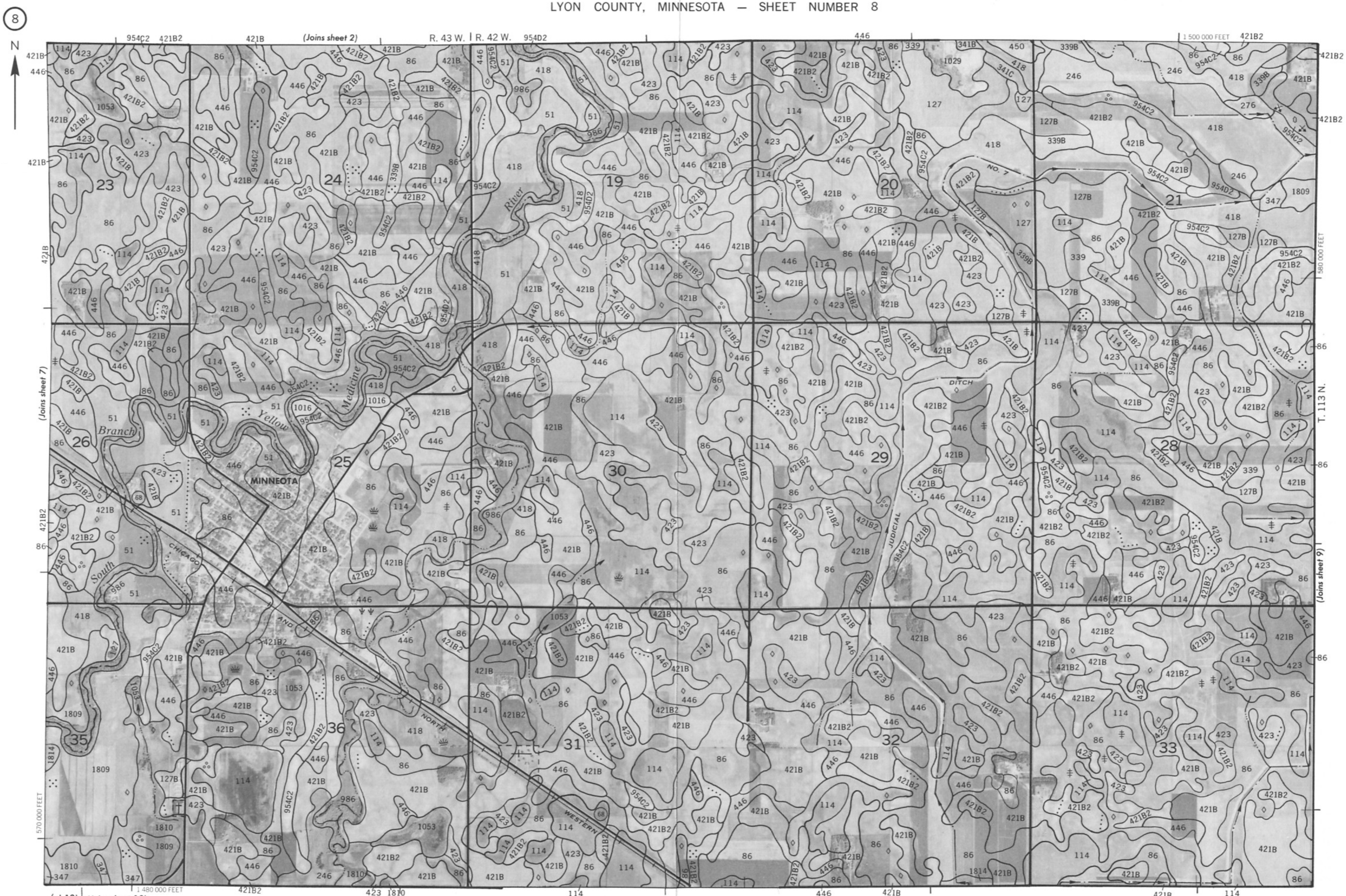
Yellow Medicine River
So. Br.
1 475 000 FEET
570 000 FEET


8
N
(Joins sheet 2)
R. 43 W.
R. 42 W.
1 500 000 FEET
580 000 FEET
T. 113 N.
(Joins sheet 7)
(Joins sheet 9)
570 000 FEET
1 480 000 FEET
(sh 12)
(Joins sheet 13)
MINNEOTA
Yellow
Medicine
River
South
Branch
CHICAGO
AND
NORTH
WESTERN
JUDICIAL
DITCH
NO. 7
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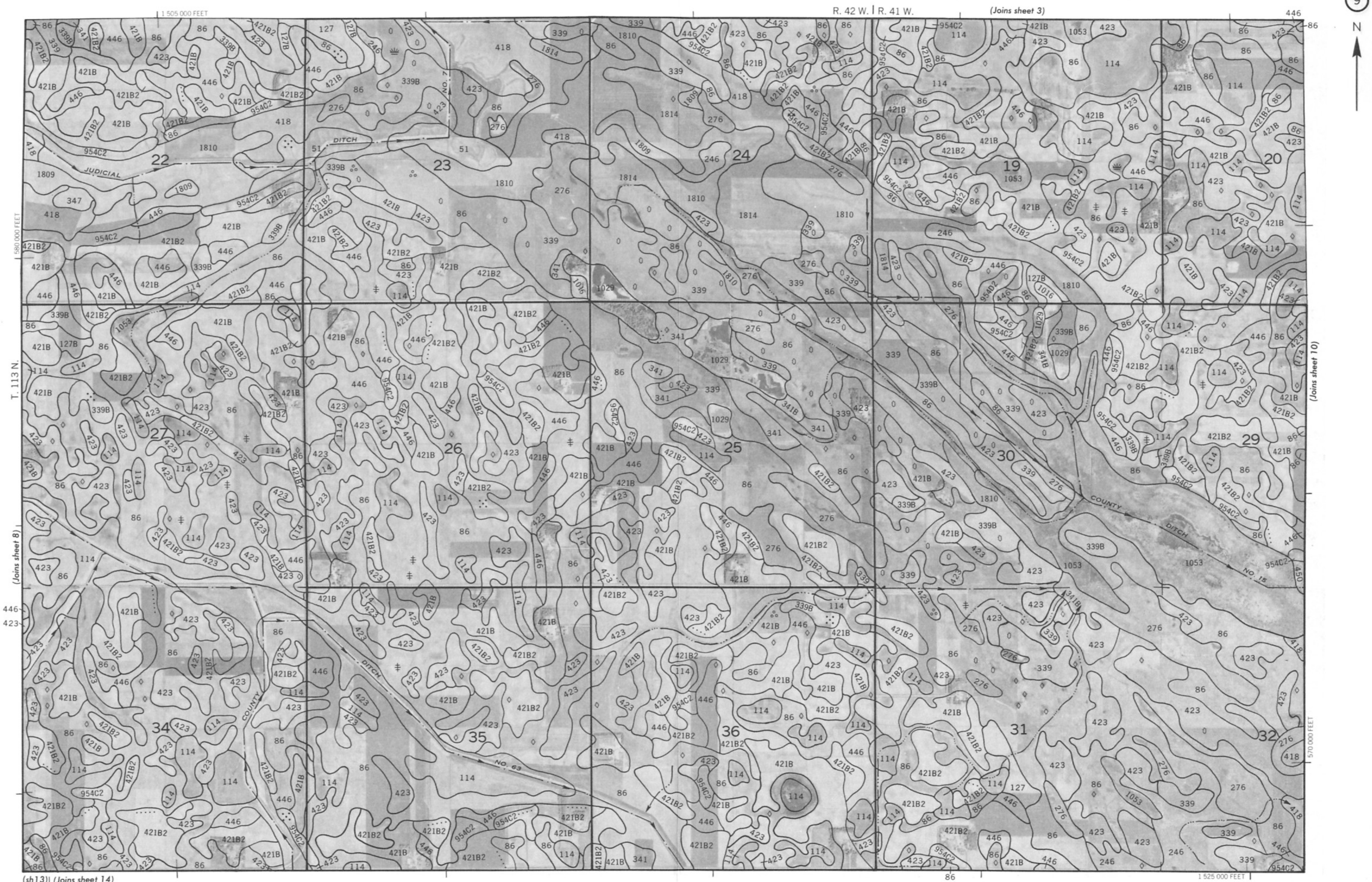
9
N
(Joins sheet 3)
R. 42 W. | R. 41 W.
1 505 000 FEET
580 000 FEET
T. 113 N.
(Joins sheet 8)
(Joins sheet 10)
570 000 FEET
(sh13) | (Joins sheet 14)
1 525 000 FEET
JUDICIAL
DITCH
NO. 7
COUNTY
DITCH
NO. 15
DITCH
NO. 63
COUNTY
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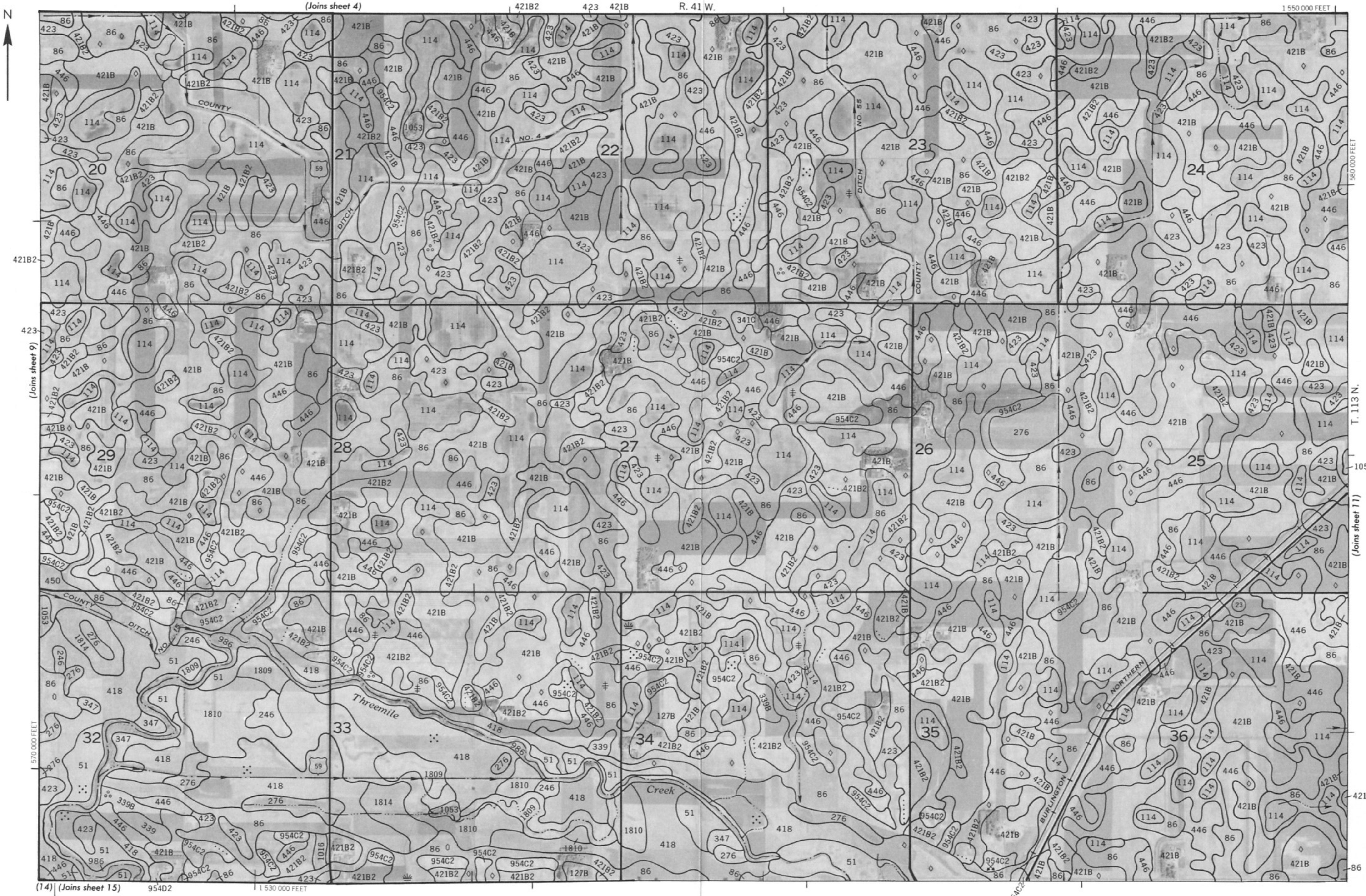
N
(Joins sheet 4)
R. 41 W.
1 550 000 FEET
580 000 FEET
T. 113 N.
(Joins sheet 9)
(Joins sheet 11)
(14) (Joins sheet 15)
1 530 000 FEET
570 000 FEET
COUNTY
NO. 4
DITCH
NO. 55
COUNTY DITCH NO.
Threemile
Creek
NORTHERN
BURLINGTON
20
21
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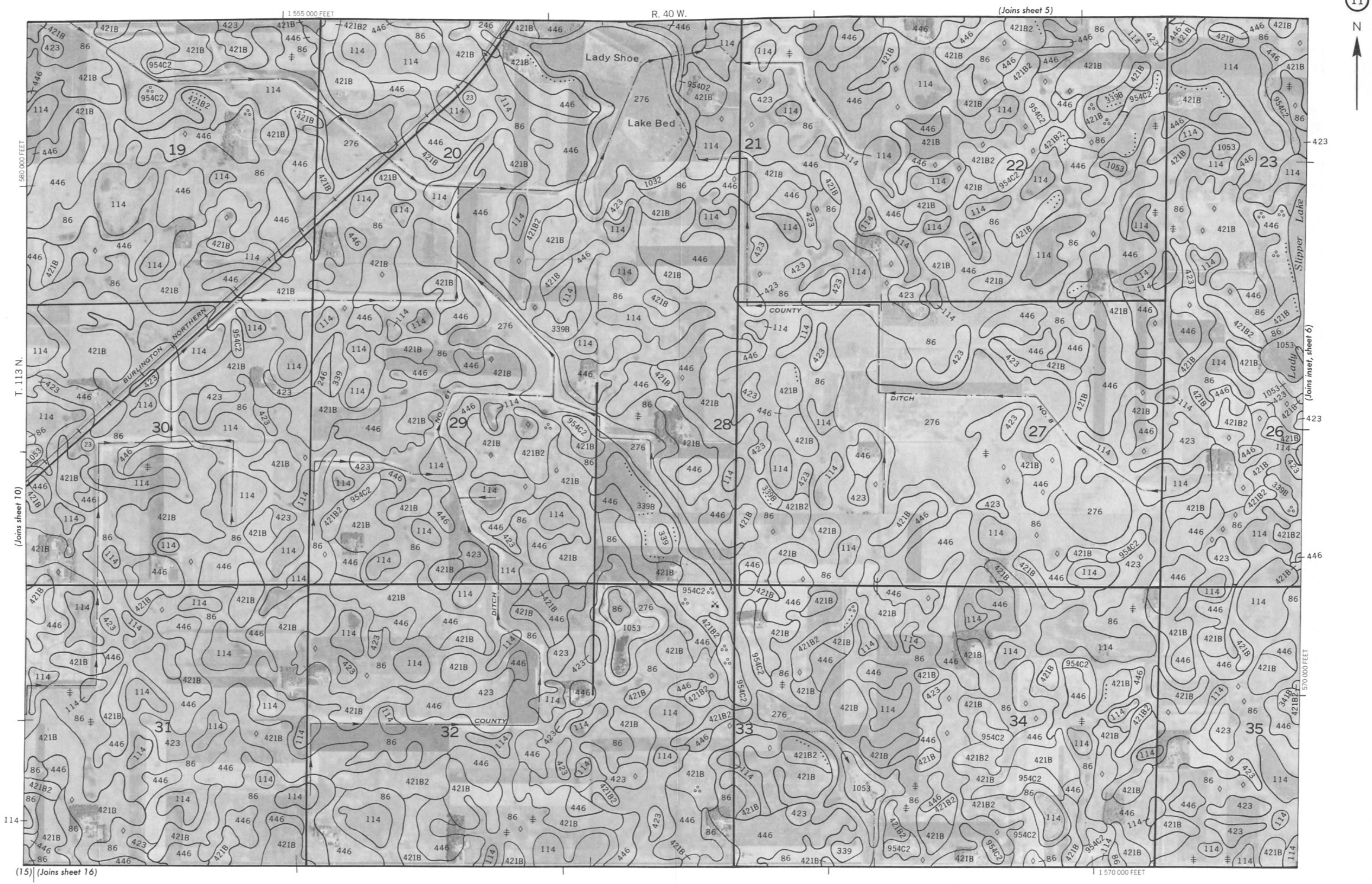
1 555 000 FEET
R. 40 W.
(Joins sheet 5)
11
N
580 000 FEET
T. 113 N.
(Joins sheet 10)
(Joins inset, sheet 6)
570 000 FEET
1 570 000 FEET
(15) (Joins sheet 16)
Lady Shoe
Lake Bed
Slipper Lake
Lady Lake
BURLINGTON NORTHERN
COUNTY
DITCH NO. 8
DITCH NO. 61
19
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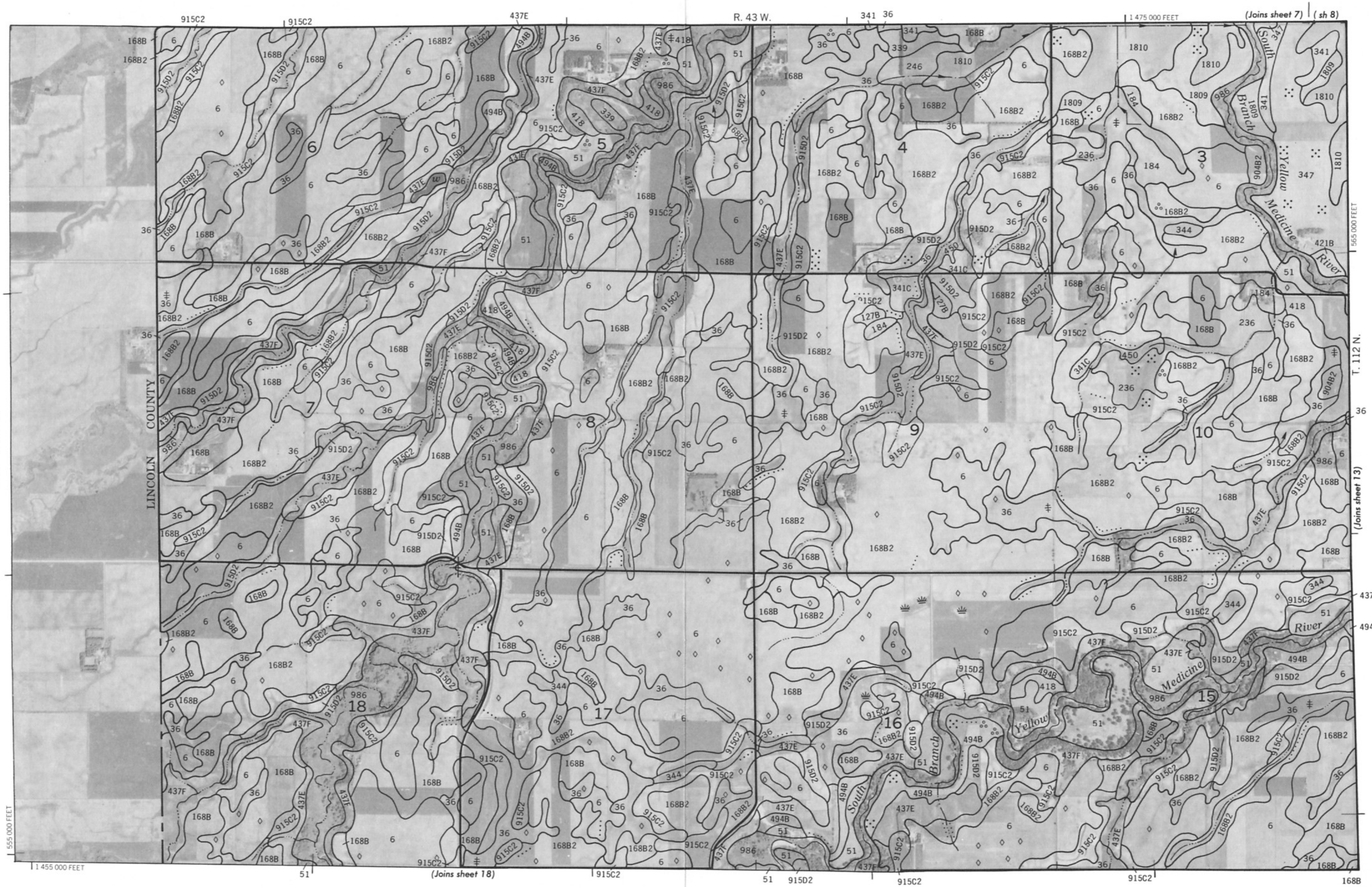
R. 43 W.
T. 112 N.
1 475 000 FEET
565 000 FEET
555 000 FEET
1 455 000 FEET
(Joins sheet 7)
(sh 8)
(Joins sheet 13)
(Joins sheet 18)
LINCOLN COUNTY
South Branch Yellow Medicine River
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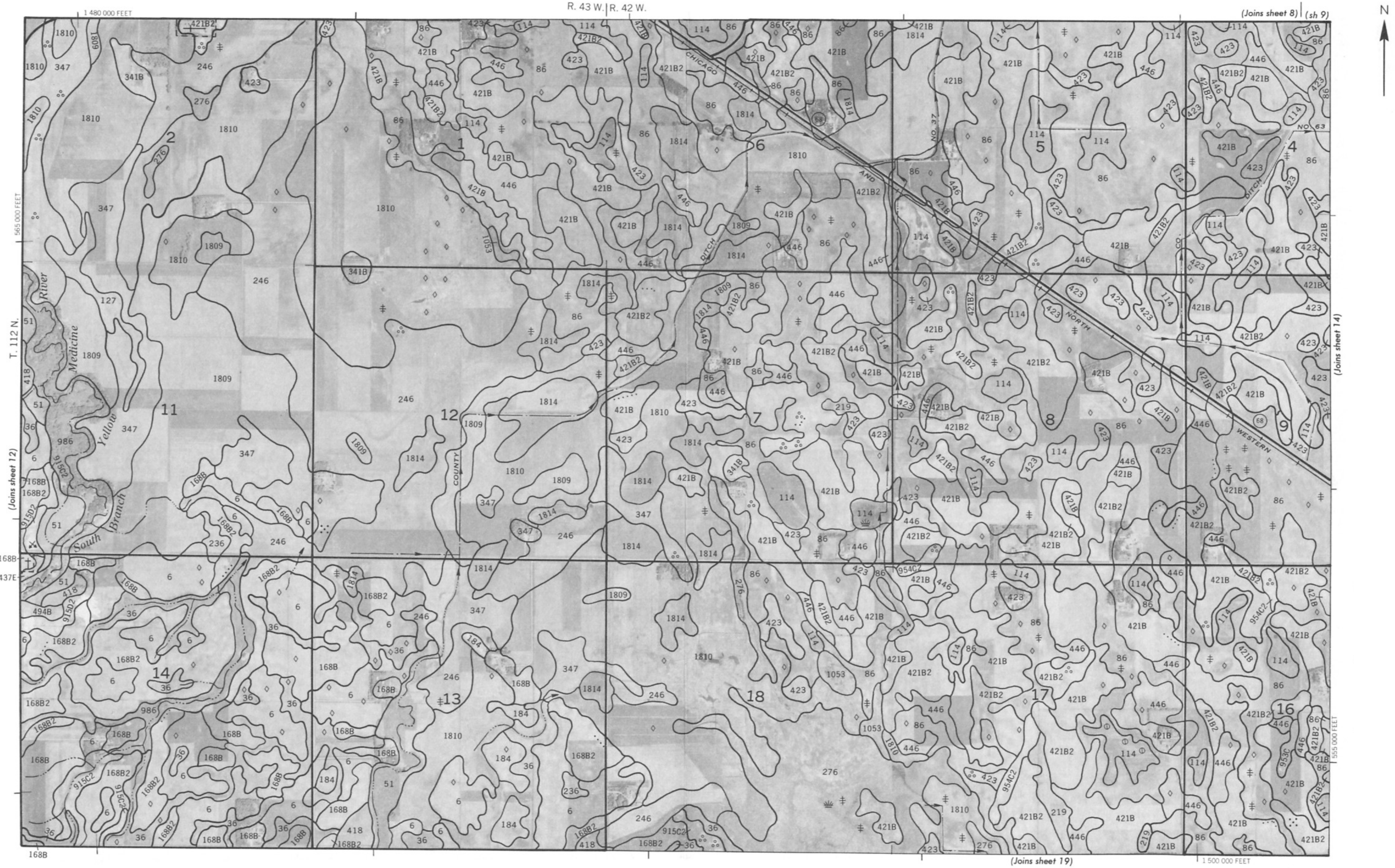
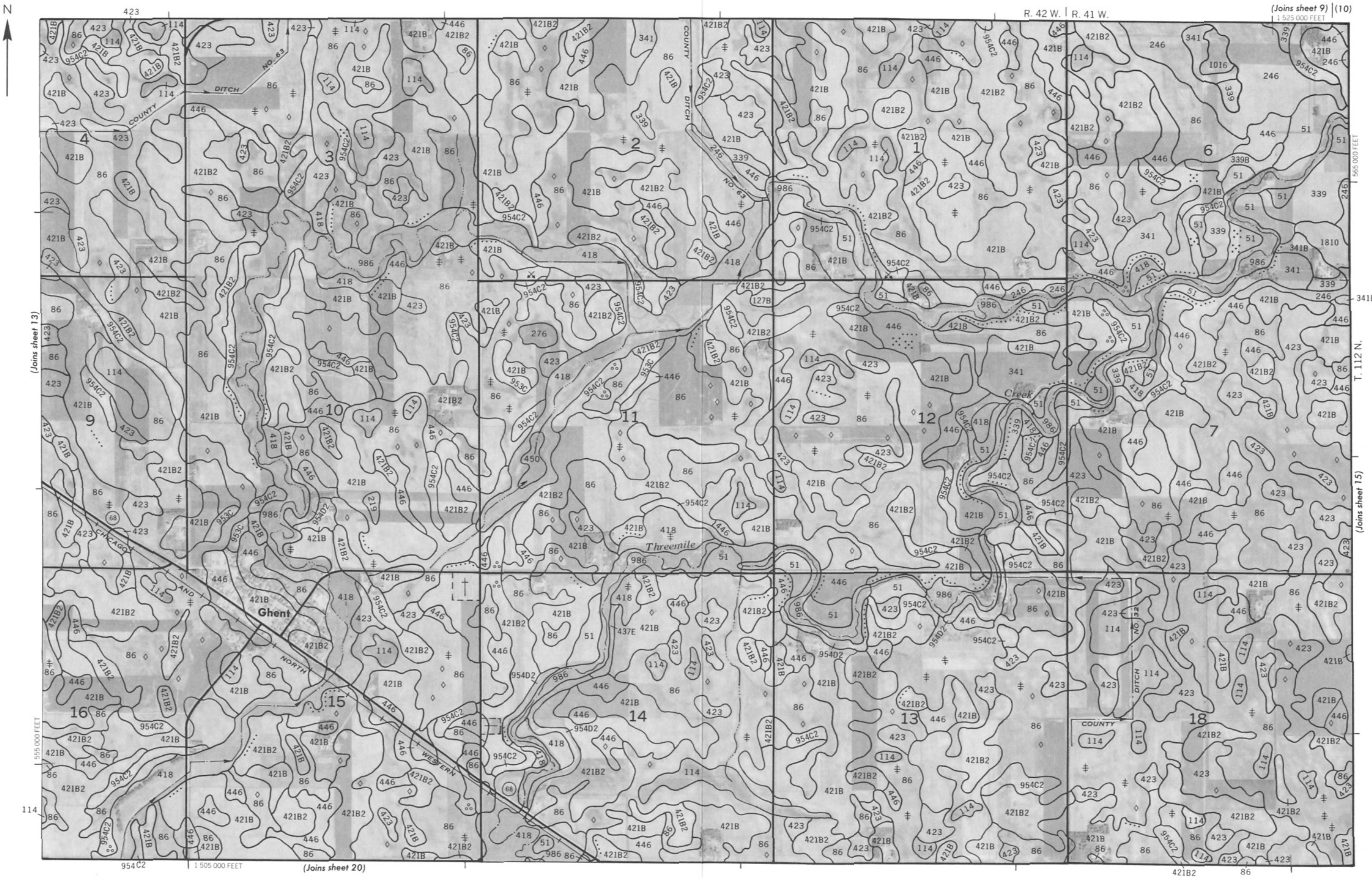
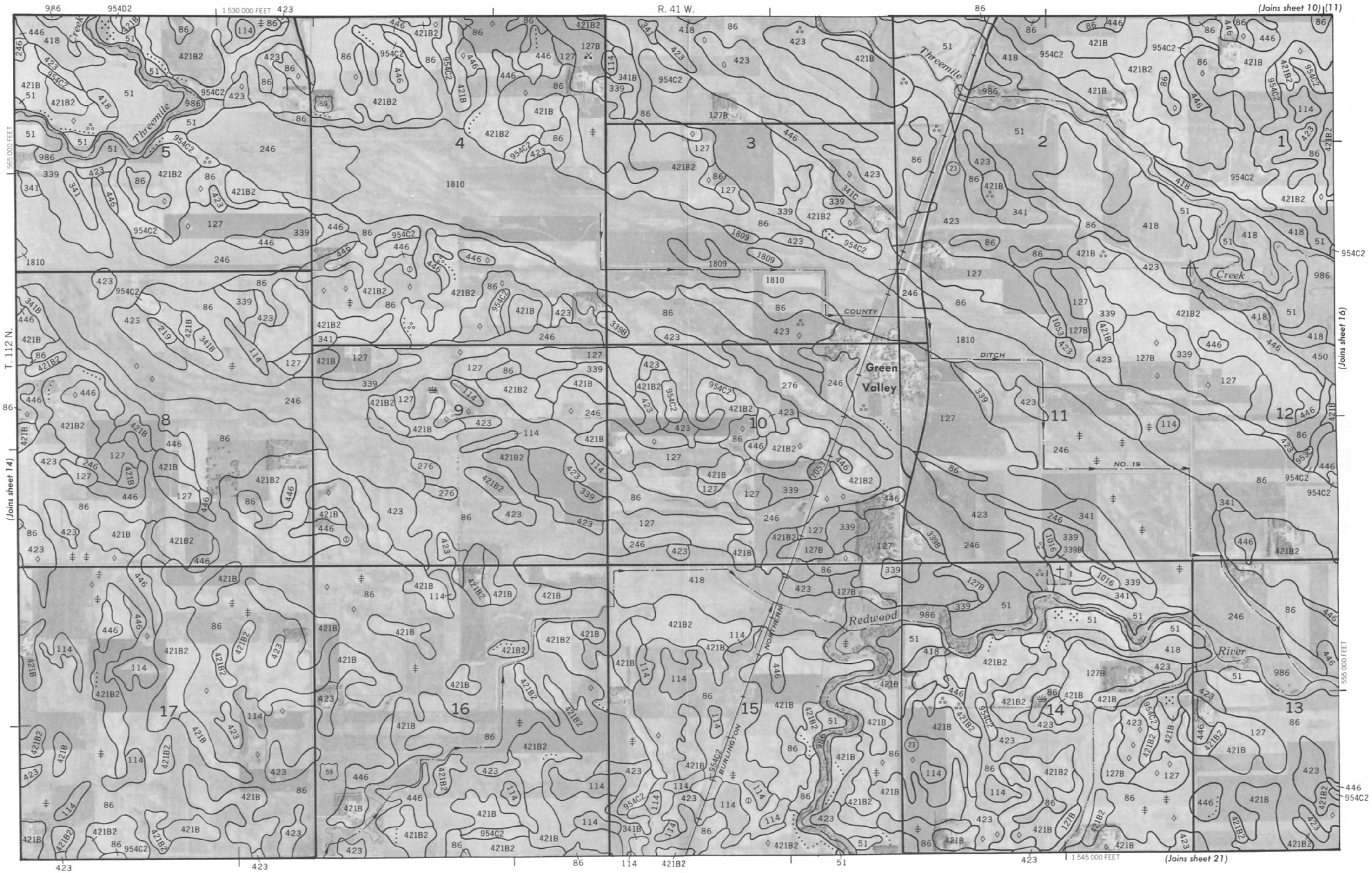
17
18

LYON COUNTY, MINNESOTA — SHEET NUMBER 13

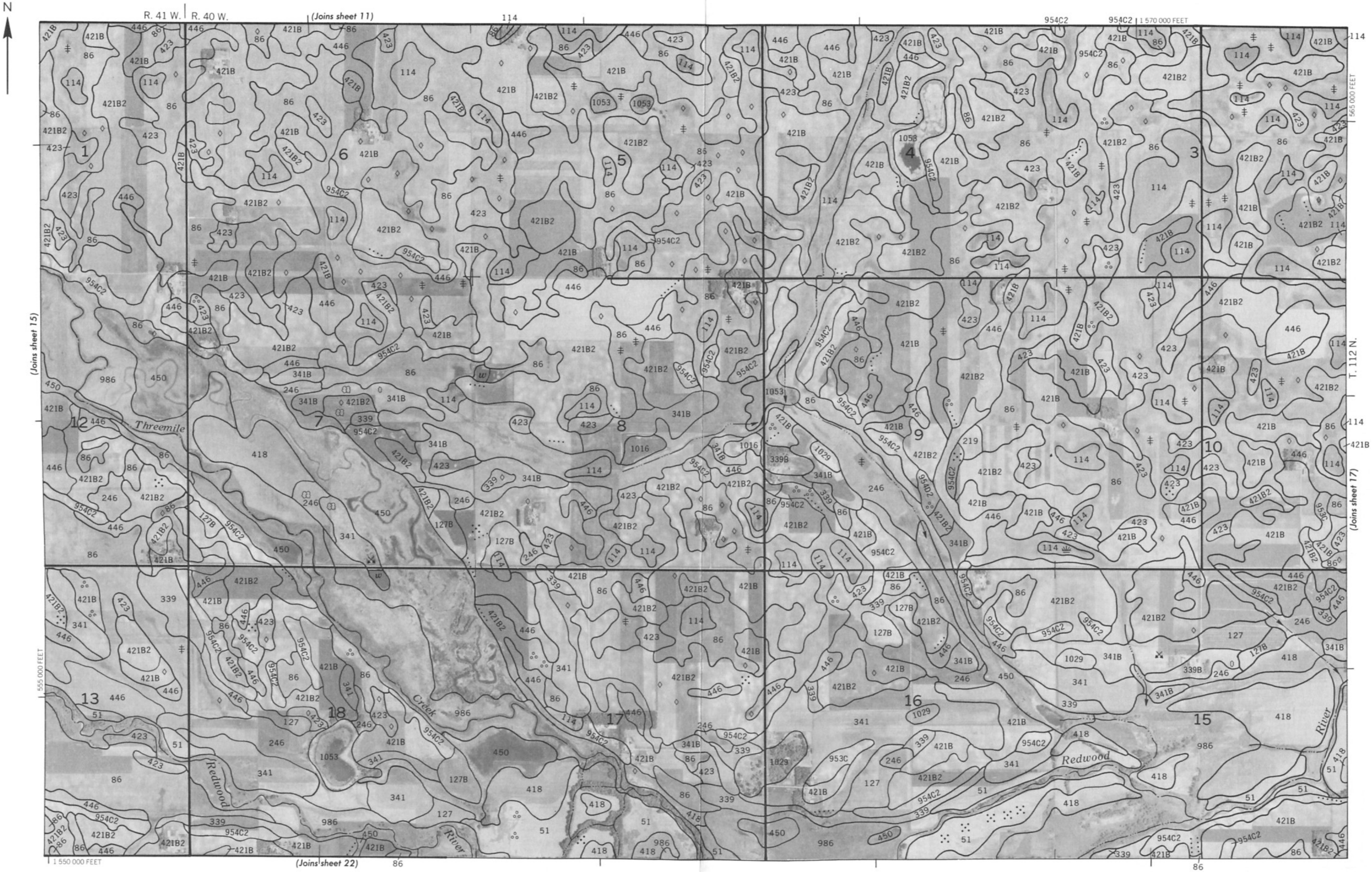


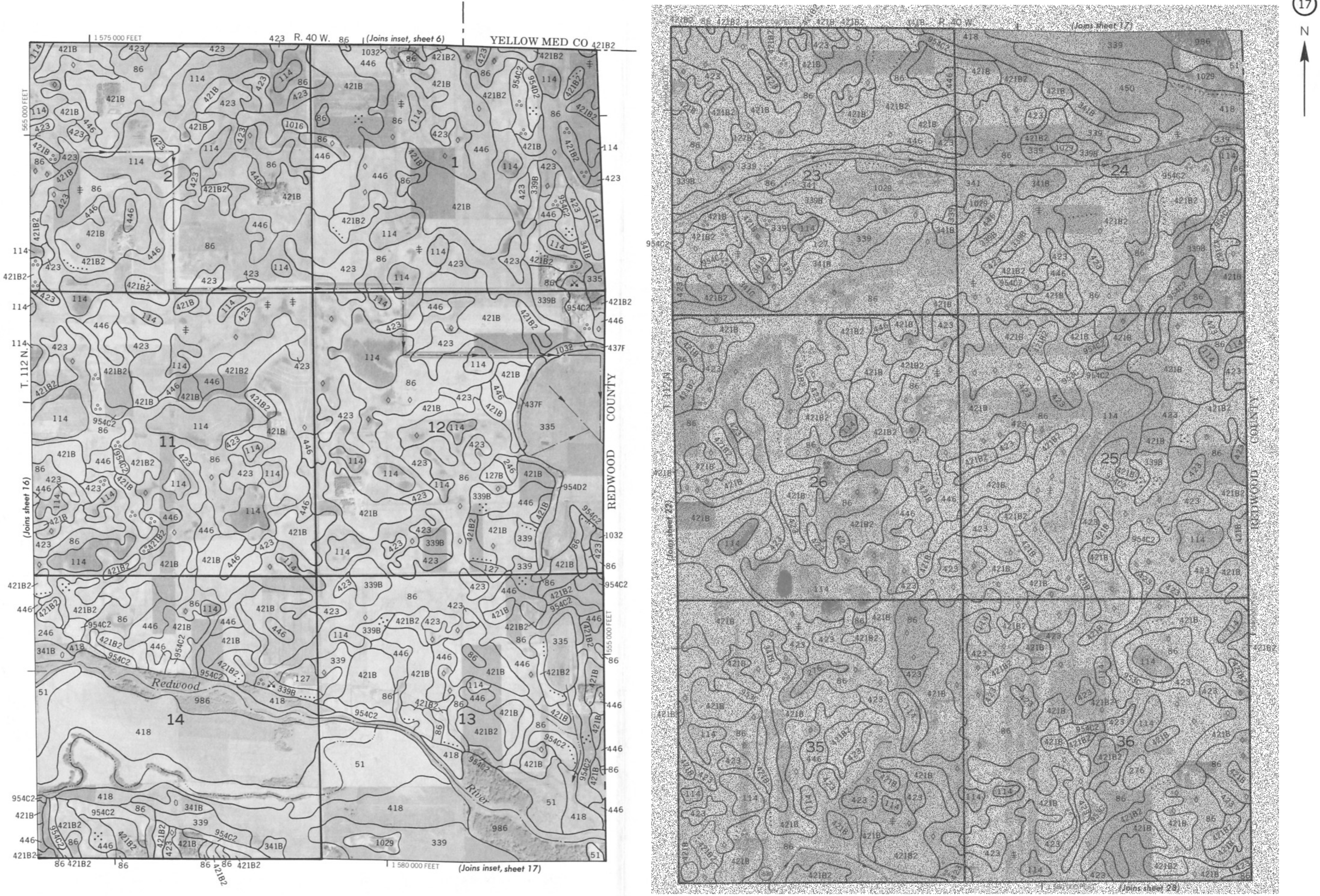

N
(Joins sheet 9)
(10)
1 525 000 FEET
R. 42 W.
R. 41 W.
565 000 FEET
T. 112 N.
(Joins sheet 13)
(Joins sheet 15)
(Joins sheet 20)
555 000 FEET
1 505 000 FEET
Ghent
Threemile
Creek
COUNTY DITCH NO. 63
CHICAGO AND NORTH WESTERN
COUNTY DITCH NO. 32
1
2
3
4
6
7
9
10
11
12
13
14
15
16
18

15


N
1 530 000 FEET
R. 41 W.
(Joins sheet 10)
(11)
T. 112 N.
565 000 FEET
555 000 FEET
1 545 000 FEET
(Joins sheet 14)
(Joins sheet 16)
(Joins sheet 21)
Threemile
Creek
Green
Valley
COUNTY
DITCH
NO. 19
Redwood
River
BURLINGTON
NORTHERN
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17

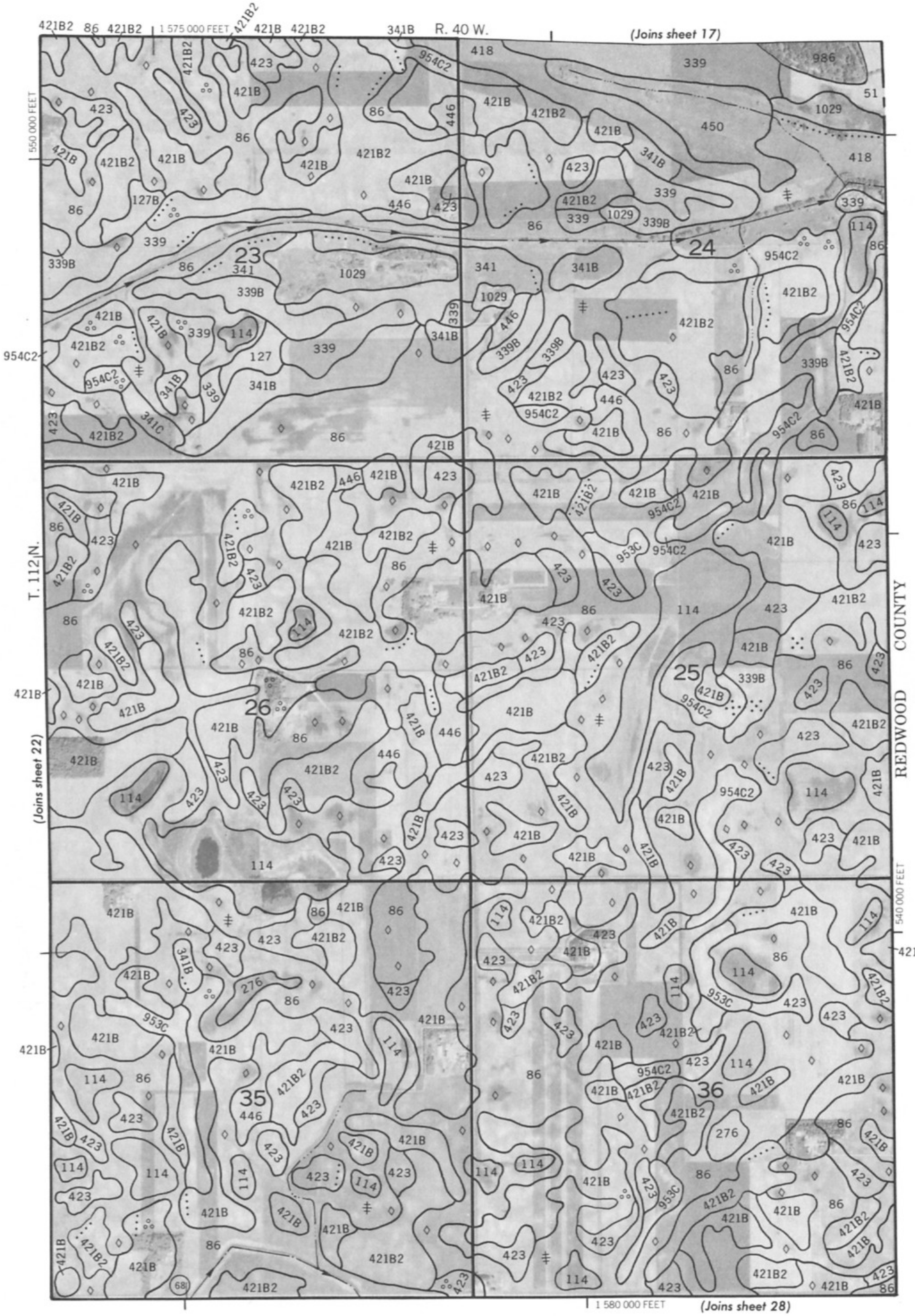
LYON COUNTY, MINNESOTA — SHEET NUMBER 16





R. 40 W.
(Joins inset, sheet 6)
YELLOW MED CO
1 575 000 FEET
565 000 FEET
T. 112 N.
(Joins sheet 16)
REDWOOD COUNTY
555 000 FEET
1 580 000 FEET
(Joins inset, sheet 17)
Redwood
River
1
2
11
12
13
14
(Joins sheet 17)
23
24
25
26
35
36
(Joins sheet 22)
(Joins sheet 28)
N


R. 40 W.
(Joins inset, sheet 6)
YELLOW MED CO
T. 112 N.
(Joins sheet 16)
REDWOOD COUNTY
Redwood
River
(Joins inset, sheet 17)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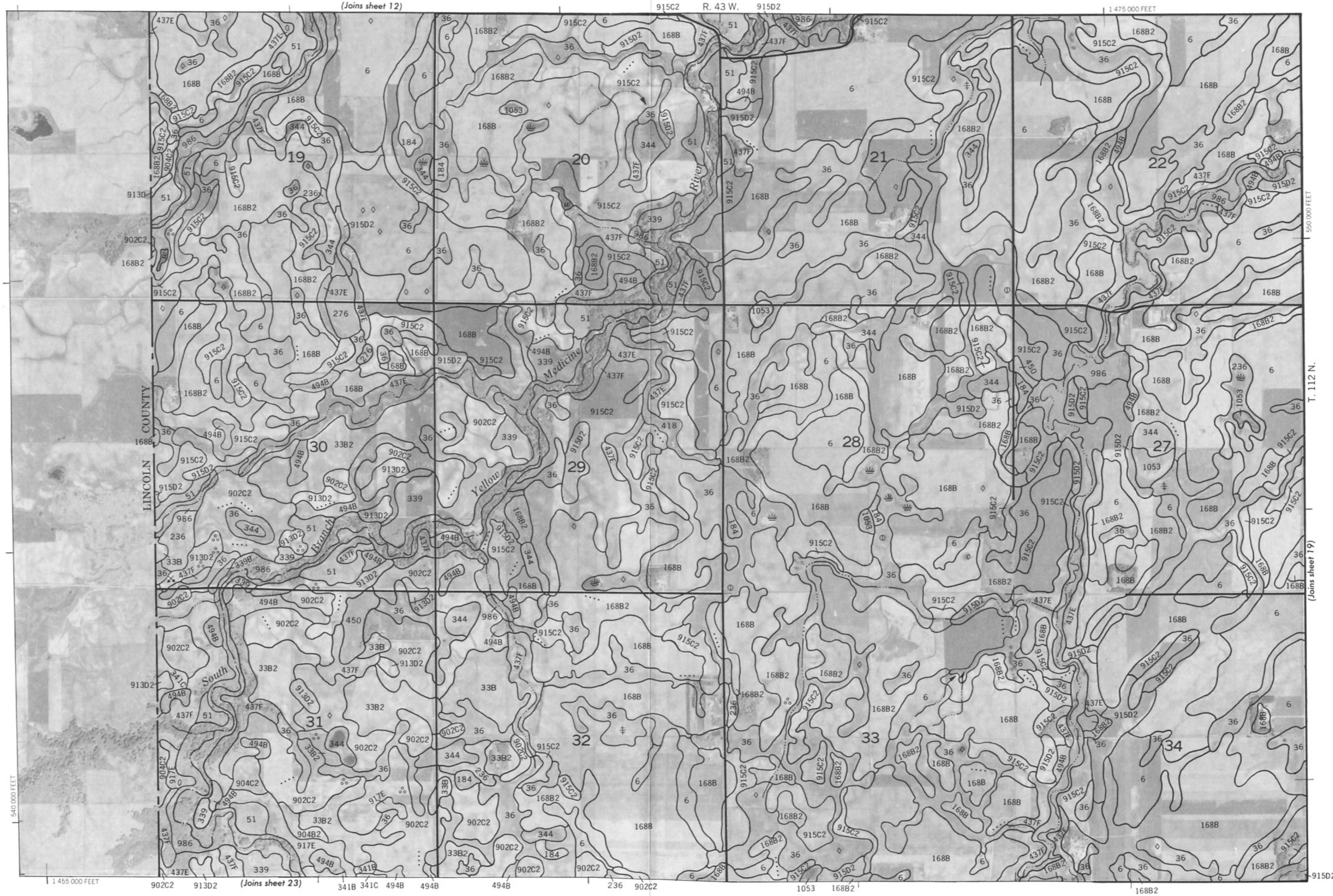
R. 40 W.
(Joins sheet 17)
550 000 FEET
T. 112 N.
(Joins sheet 22)
REDWOOD COUNTY
540 000 FEET
1 580 000 FEET
(Joins sheet 28)
N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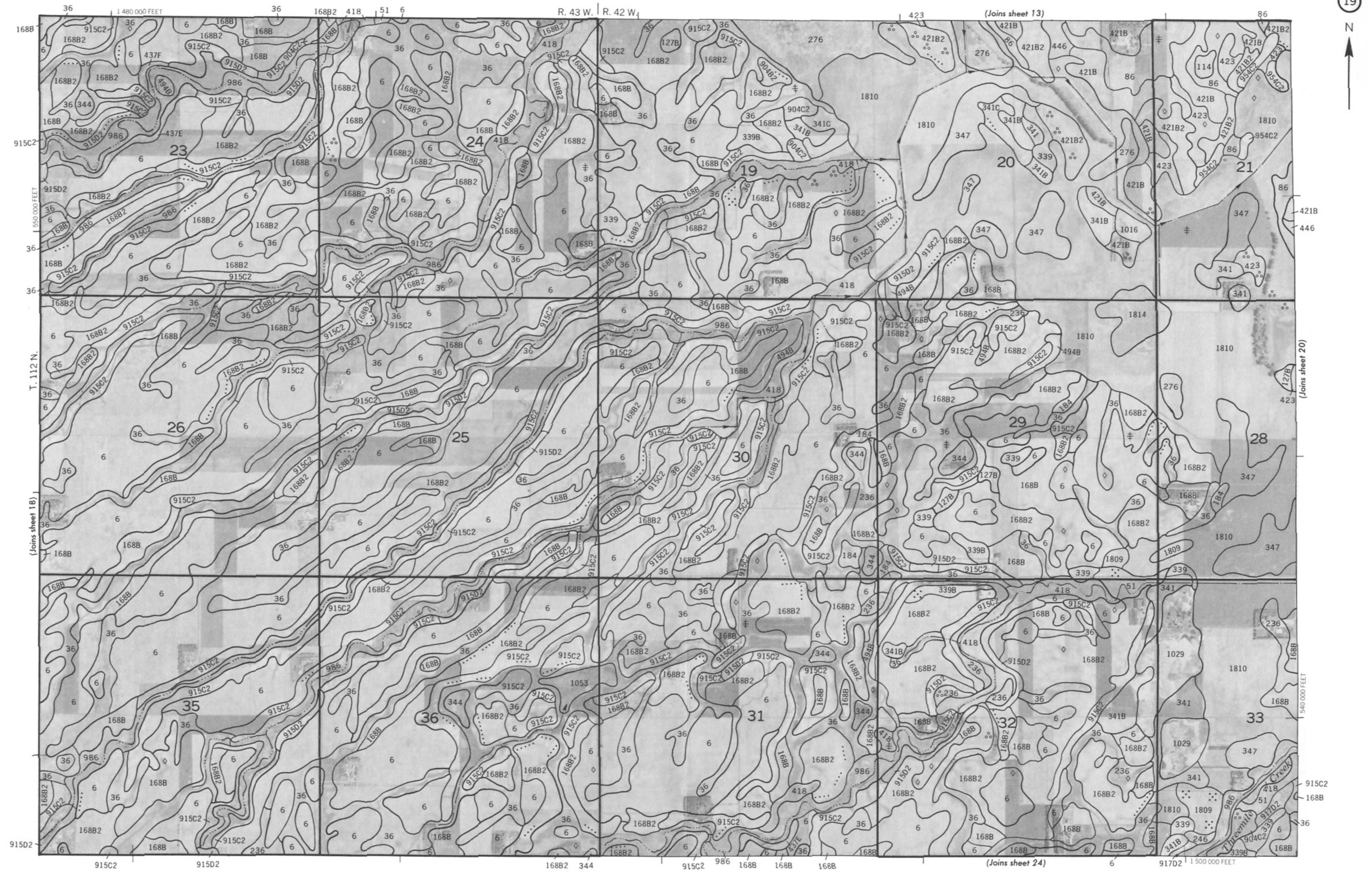
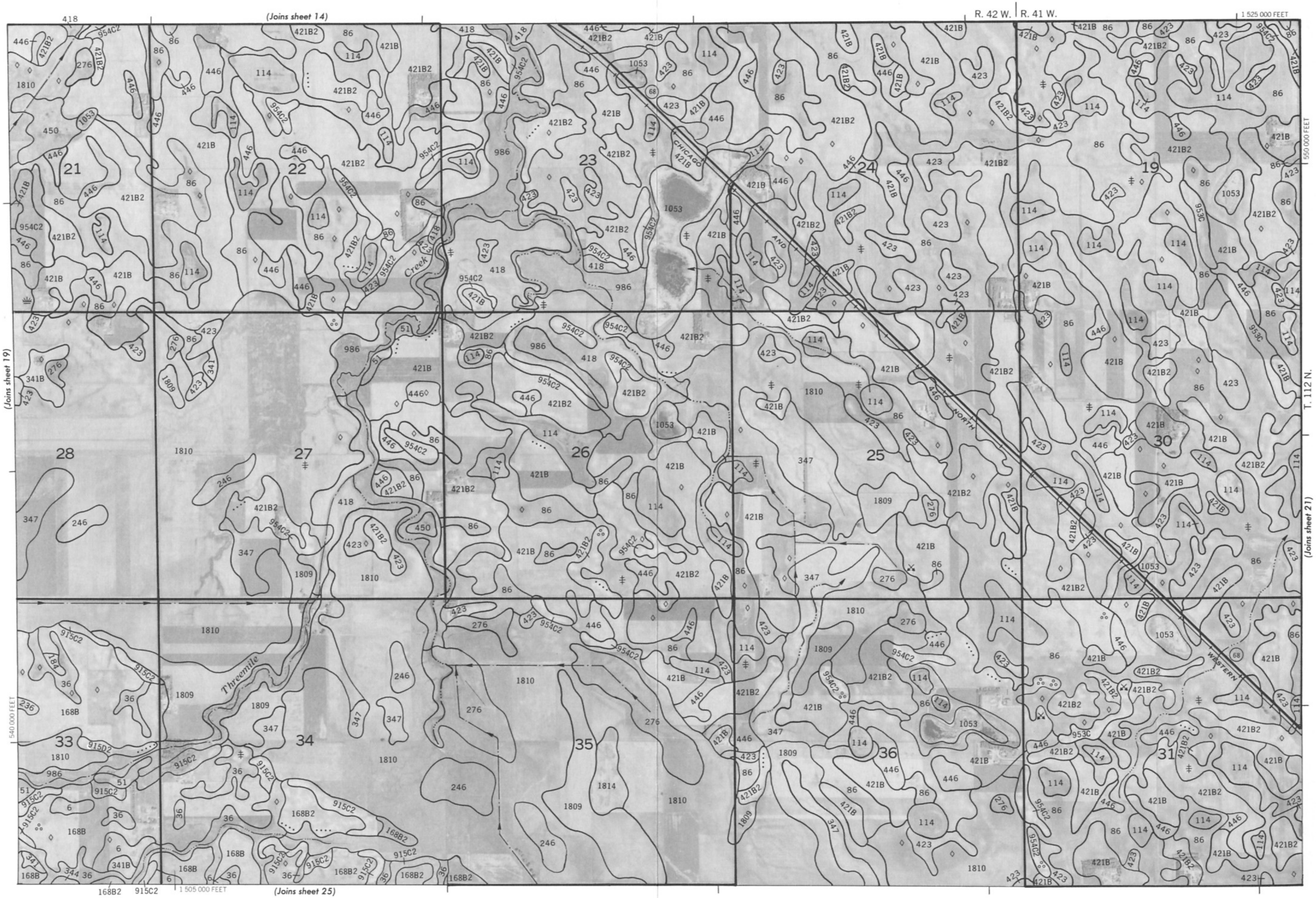
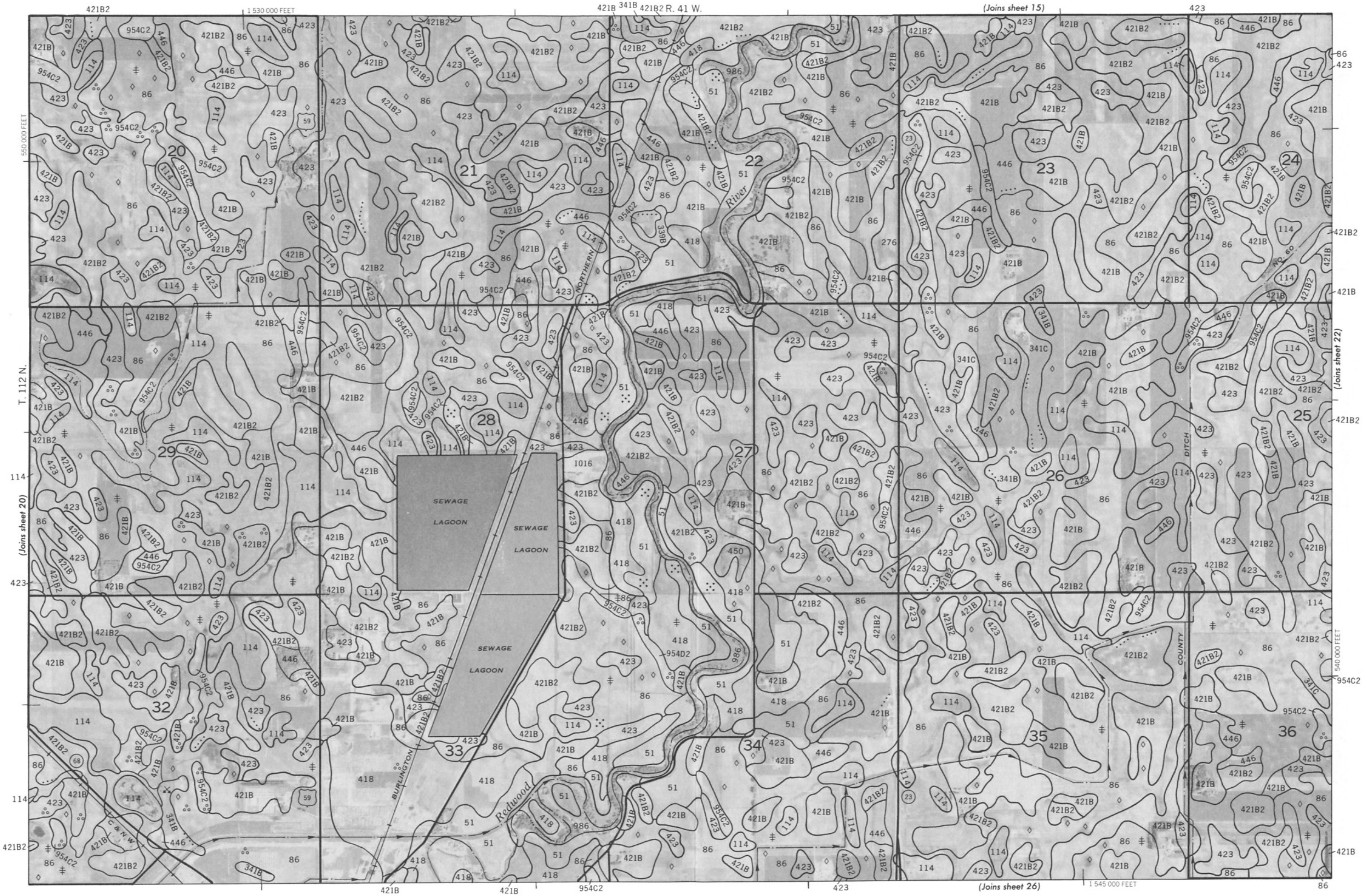
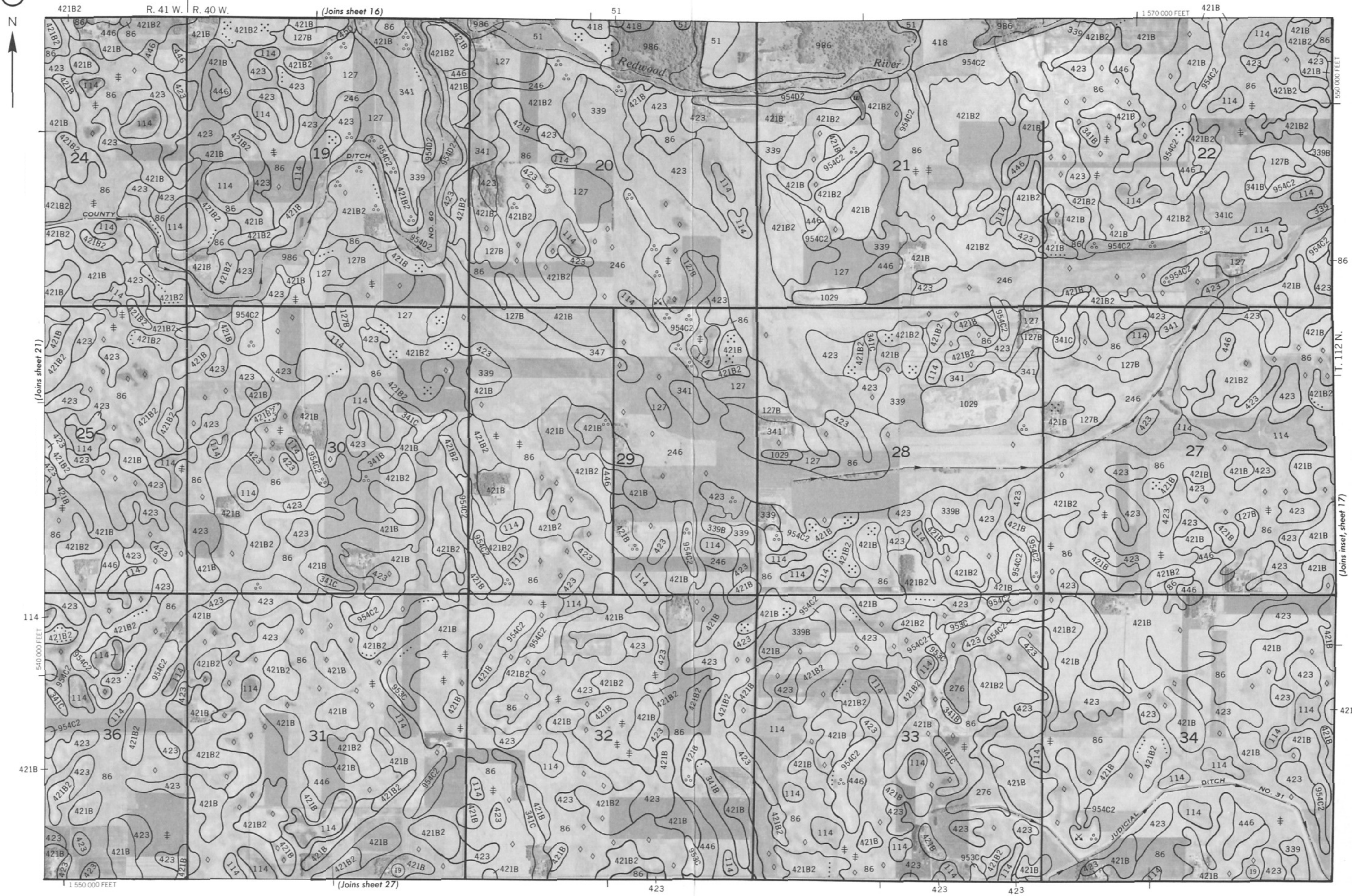
(Joins sheet 12)
R. 43 W.
1 475 000 FEET
550 000 FEET
T. 112 N.
(Joins sheet 19)
(Joins sheet 23)
1 455 000 FEET
540 000 FEET
LINCOLN COUNTY
Medicine
River
Yellow
South
Branch
19
20
21
22
27
28
29
30
31
32
33
34

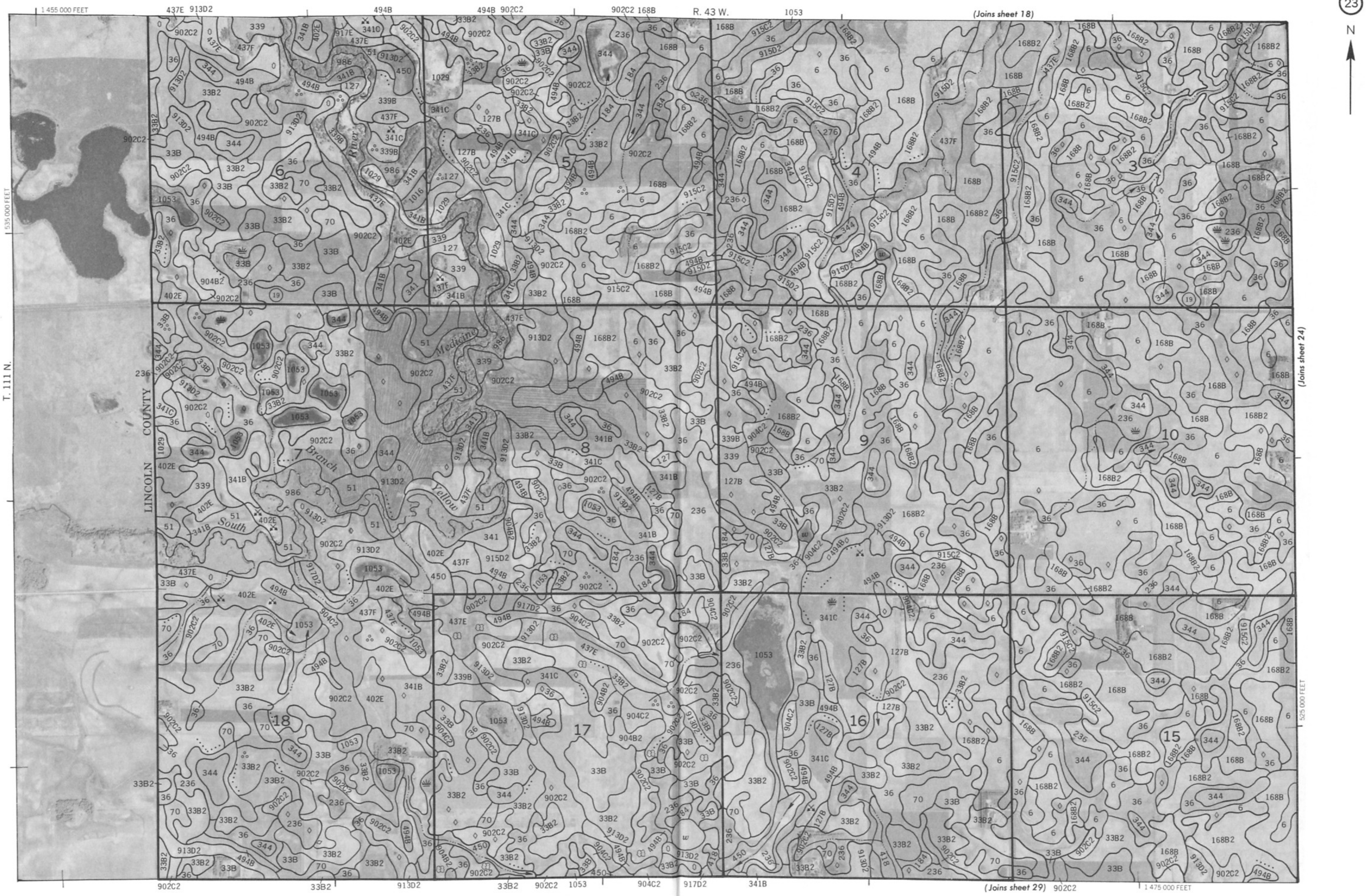

19
N
(Joins sheet 13)
(Joins sheet 18)
(Joins sheet 20)
(Joins sheet 24)
R. 43 W.
R. 42 W.
T. 112 N.
1 480 000 FEET
1 500 000 FEET
550 000 FEET
540 000 FEET
Threemile Creek
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36


N
(Joins sheet 14)
(Joins sheet 19)
(Joins sheet 21)
(Joins sheet 25)
R. 42 W.
R. 41 W.
T. 112 N.
1 525 000 FEET
550 000 FEET
540 000 FEET
1 505 000 FEET
21
22
23
24
19
28
27
26
25
30
33
34
35
36
31
Creek
Threemile
CHICAGO
AND
NORTH
WESTERN
68



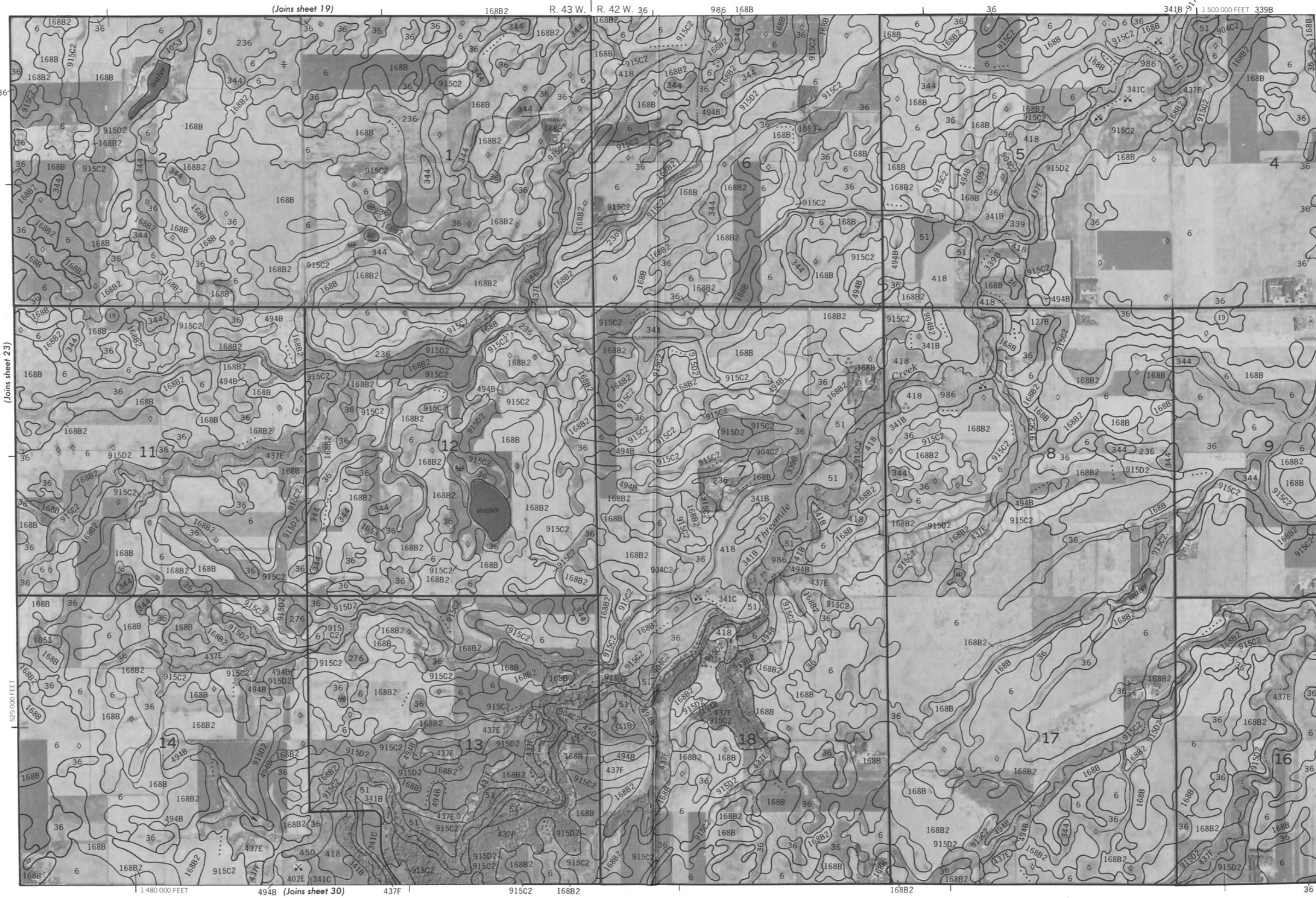
N
(Joins sheet 15)
(Joins sheet 20)
(Joins sheet 22)
(Joins sheet 26)
R. 41 W.
T. 112 N.
1 530 000 FEET
1 545 000 FEET
550 000 FEET
540 000 FEET
SEWAGE LAGOON
SEWAGE LAGOON
SEWAGE LAGOON
River
Redwood
NORTHERN
BURLINGTON
C & N W
COUNTY
DITCH
NO. 60
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36

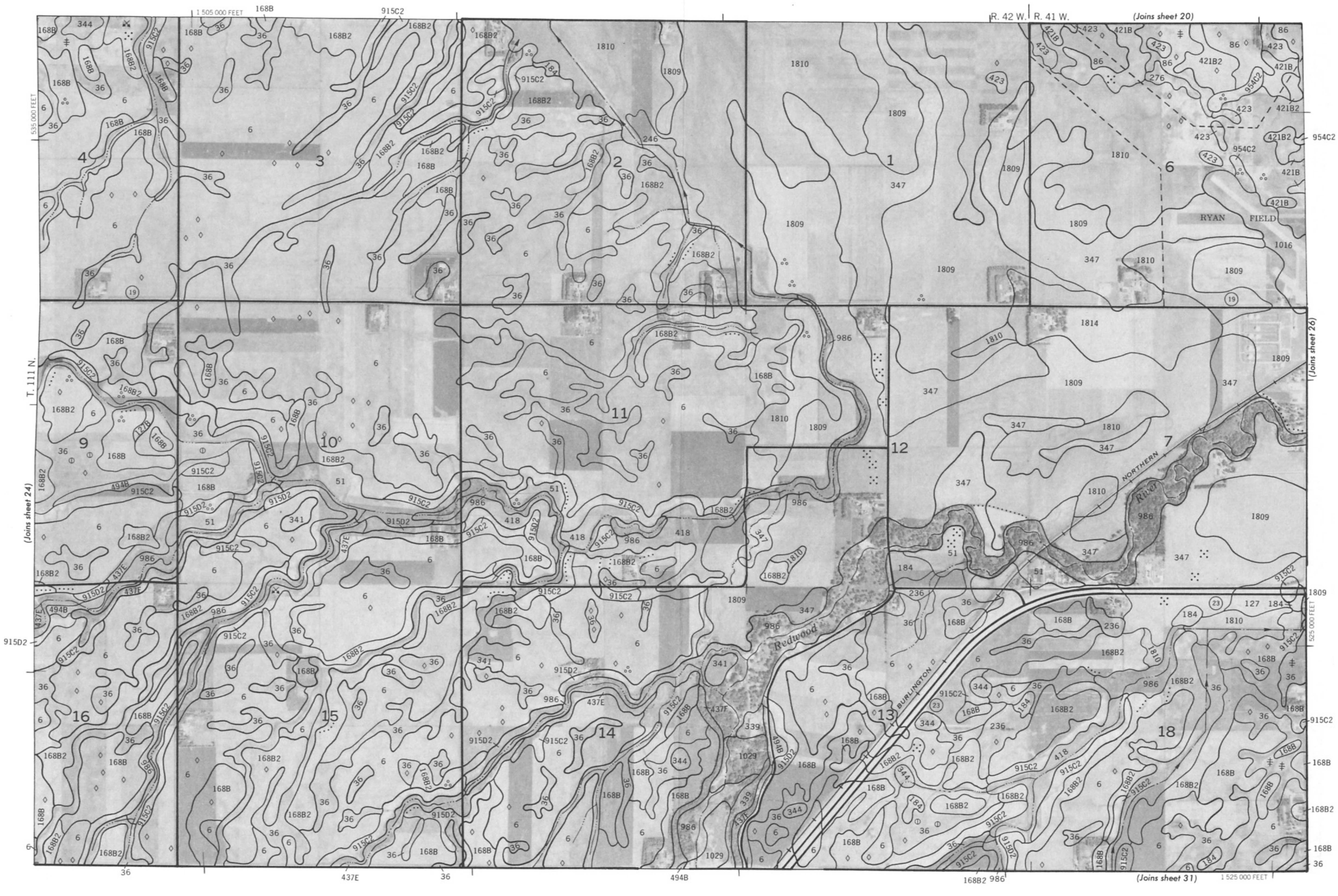

N
R. 41 W.
R. 40 W.
(Joins sheet 16)
(Joins sheet 21)
(Joins inset, sheet 17)
(Joins sheet 27)
T. 112 N.
1 570 000 FEET
550 000 FEET
540 000 FEET
1 550 000 FEET
Redwood
River
COUNTY
DITCH
NO. 60
DITCH
NO. 31
JUDICIAL
24
19
20
21
22
25
30
29
28
27
36
31
32
33
34

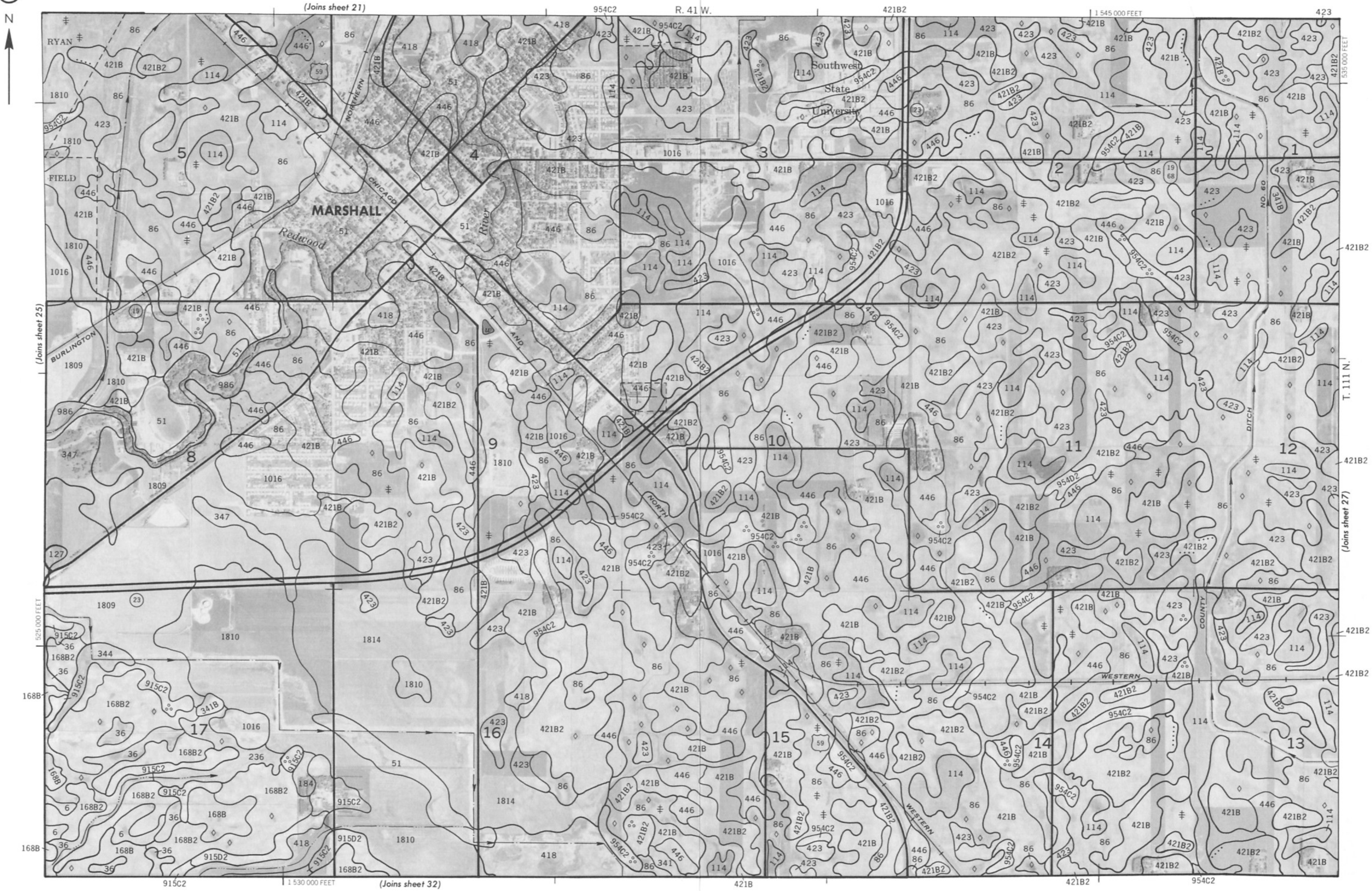

23
N
1 455 000 FEET
R. 43 W.
(Joins sheet 18)
(Joins sheet 24)
(Joins sheet 29)
535 000 FEET
525 000 FEET
1 475 000 FEET
T. 111 N.
LINCOLN COUNTY
Yellow Medicine River
South Branch
3
4
5
6
7
8
9
10
15
16
17
18

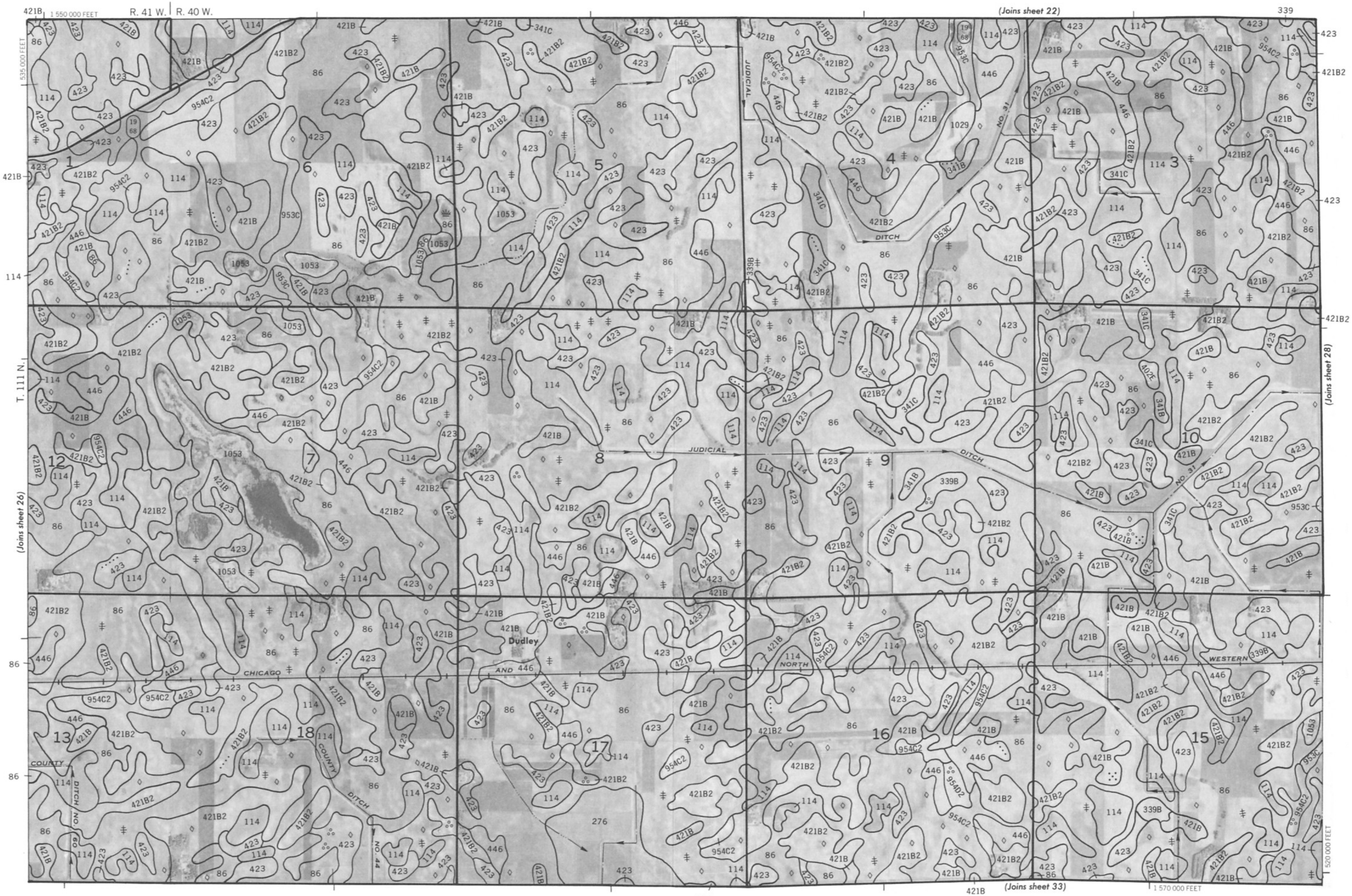
LYON COUNTY, MINNESOTA — SHEET NUMBER 24

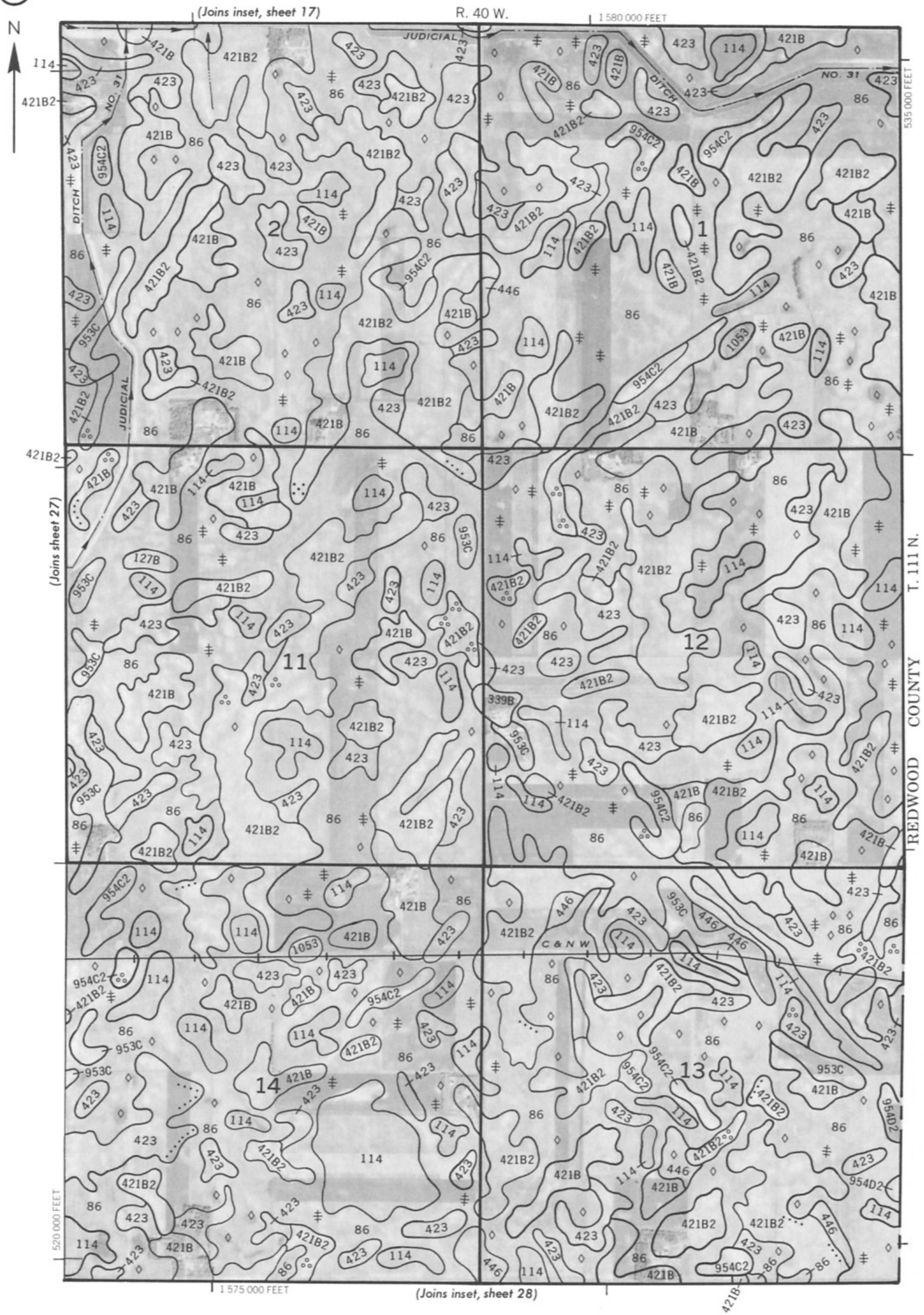
N

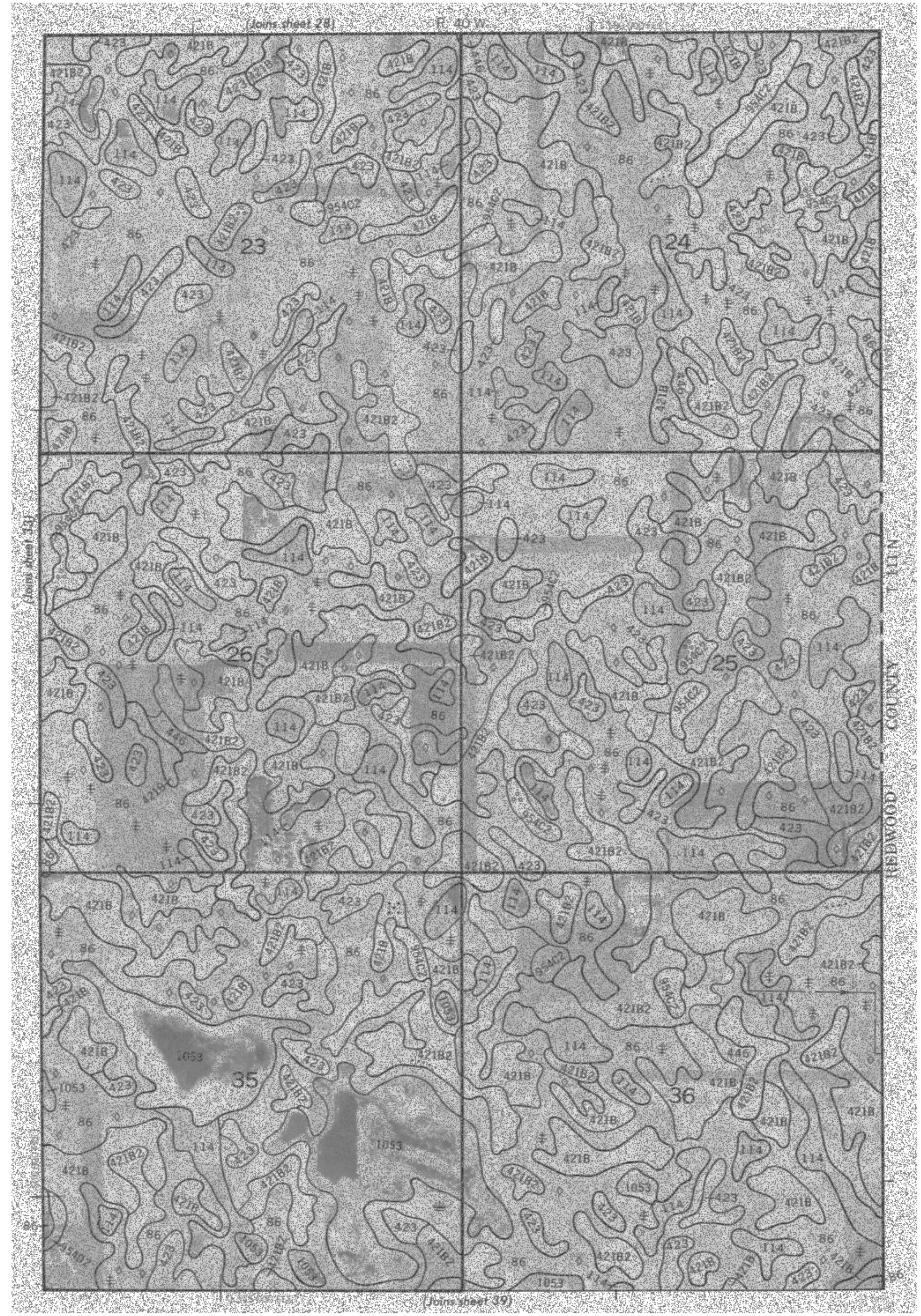



25
N
1 505 000 FEET
535 000 FEET
525 000 FEET
1 525 000 FEET
R. 42 W.
R. 41 W.
T. 111 N.
(Joins sheet 20)
(Joins sheet 26)
(Joins sheet 24)
(Joins sheet 31)
RYAN FIELD
NORTHERN
River
Redwood
BURLINGTON
1
2
3
4
6
7
9
10
11
12
13
14
15
16
18

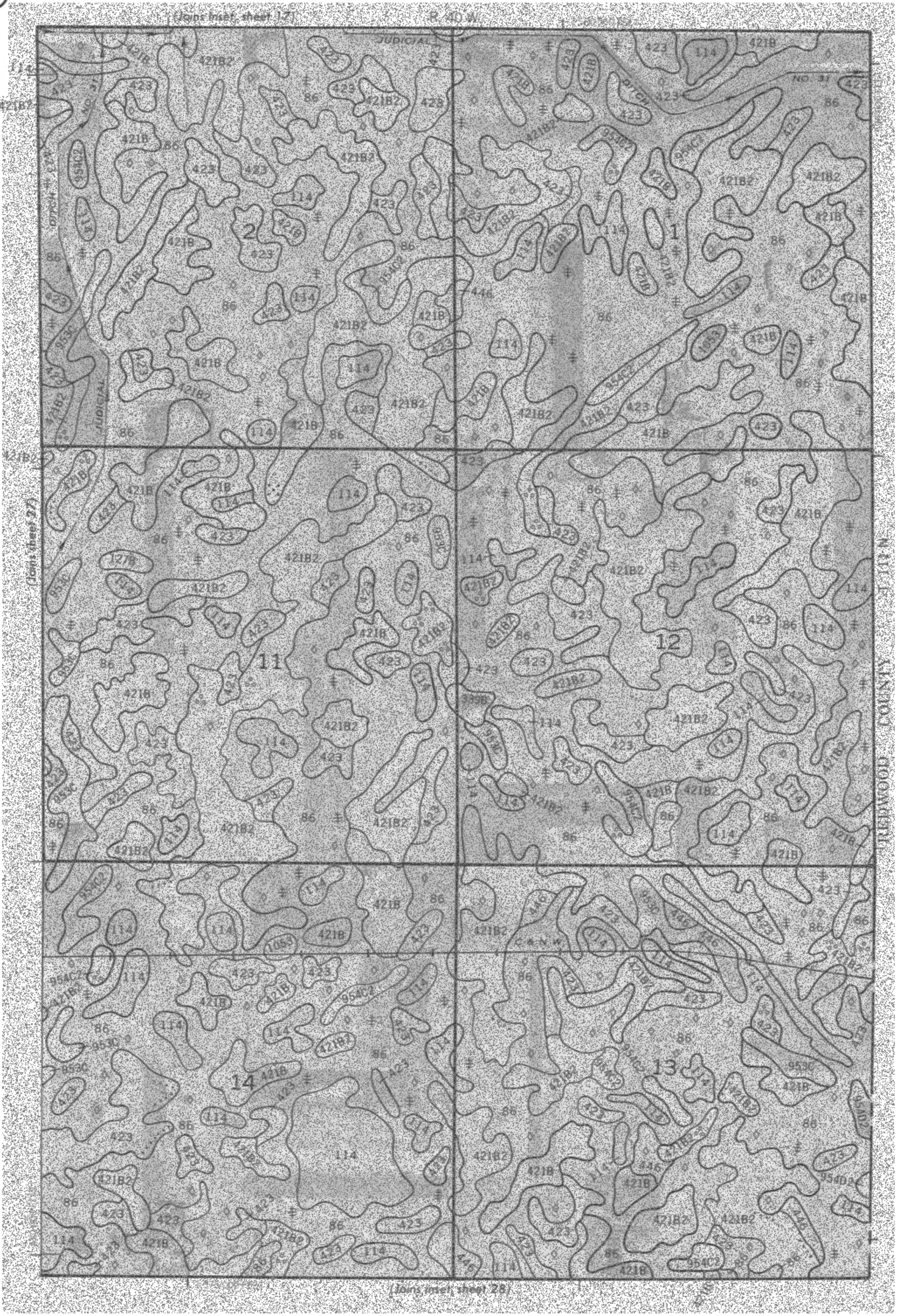

N
(Joins sheet 21)
R. 41 W.
1 545 000 FEET
535 000 FEET
(Joins sheet 25)
(Joins sheet 27)
T. 111 N.
525 000 FEET
1 530 000 FEET
(Joins sheet 32)
MARSHALL
Southwest
State
University
RYAN
FIELD
BURLINGTON
NORTHERN
CHICAGO
AND
NORTH
WESTERN
Redwood
River
DITCH
COUNTY
NO. 60
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17

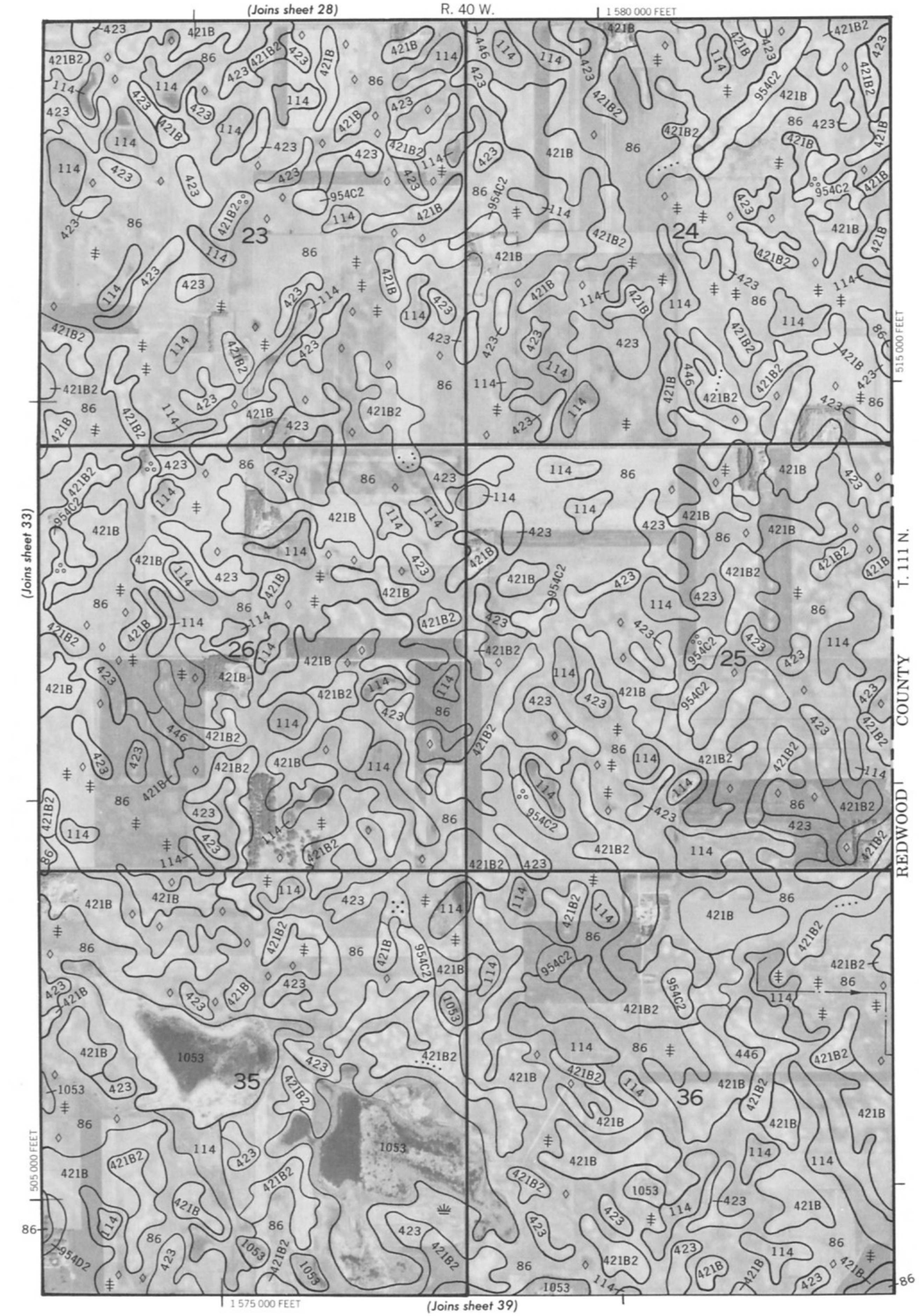

N
R. 41 W.
R. 40 W.
1 550 000 FEET
535 000 FEET
(Joins sheet 22)
(Joins sheet 26)
(Joins sheet 28)
(Joins sheet 33)
T. 111 N.
1 570 000 FEET
520 000 FEET
Dudley
JUDICIAL
DITCH
NO. 31
CHICAGO
AND
NORTH
WESTERN
COUNTY
DITCH
NO. 60
NO. 44
1
3
4
5
6
7
8
9
10
12
13
15
16
17
18

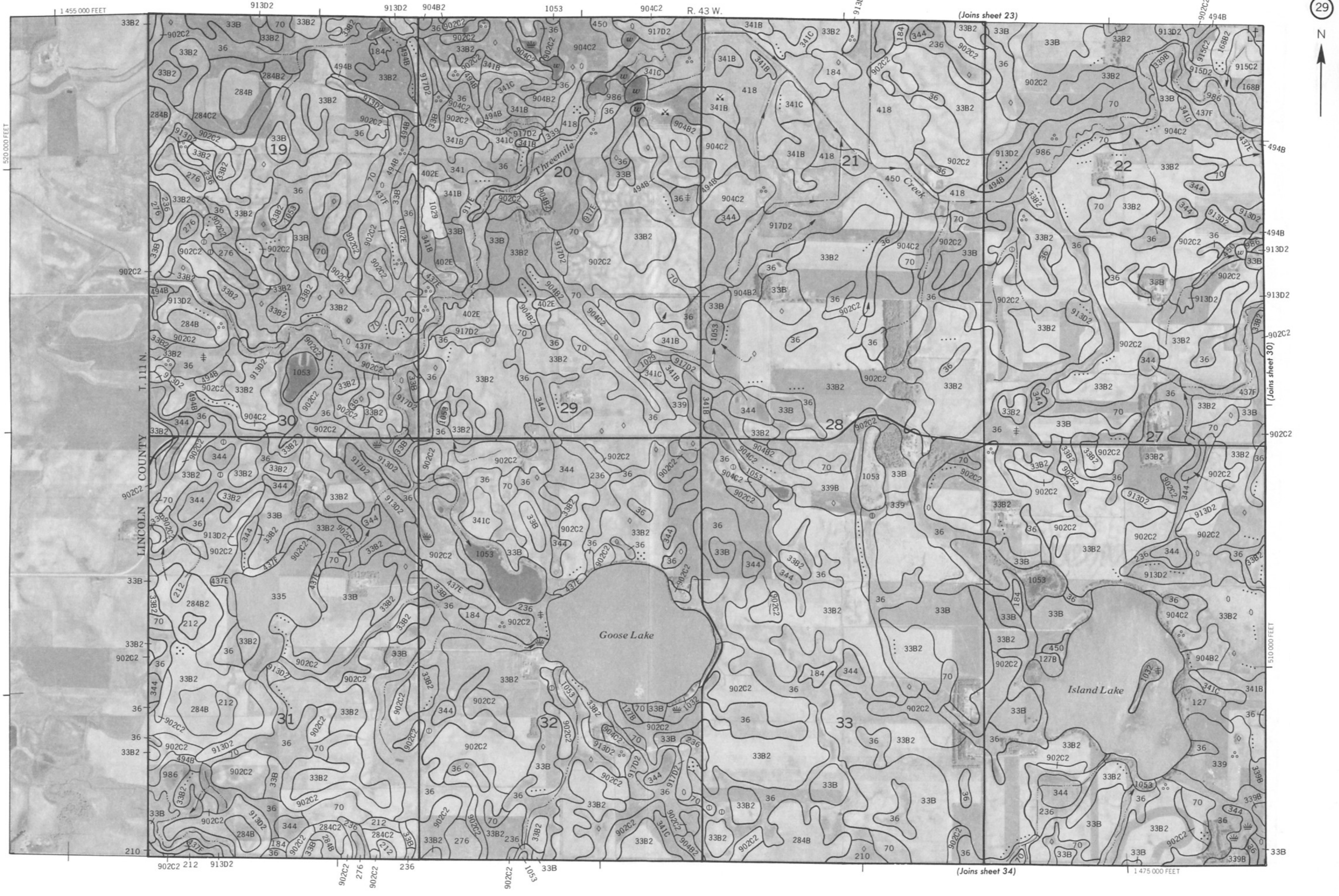

N
(Joins inset, sheet 17)
R. 40 W.
1 580 000 FEET
535 000 FEET
JUDICIAL
DITCH NO. 31
(Joins sheet 27)
T. 111 N.
REDWOOD COUNTY
C & N W
2
1
11
12
14
13
520 000 FEET
1 575 000 FEET
(Joins inset, sheet 28)


R. 40 W.
23
24
26
25
35
36
T. 111 N.
REDWOOD COUNTY
(Joins sheet 39)

N

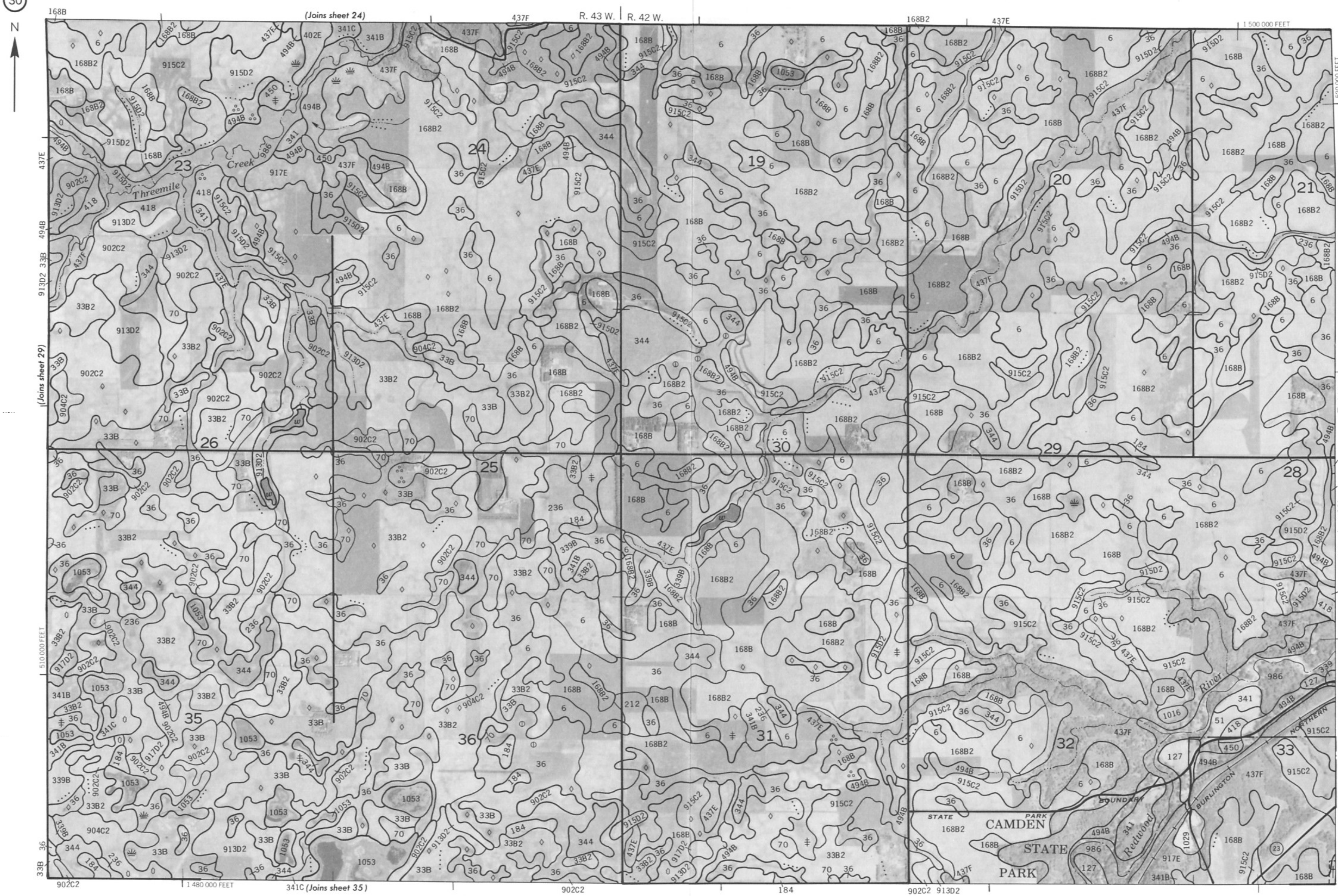

(Joins inset, sheet 17)
R. 40 W.
JUDICIAL
DITCH
NO. 31
(Joins sheet 27)
2
1
11
12
14
13
T. 111 N.
REDWOOD COUNTY
(Joins inset, sheet 28)

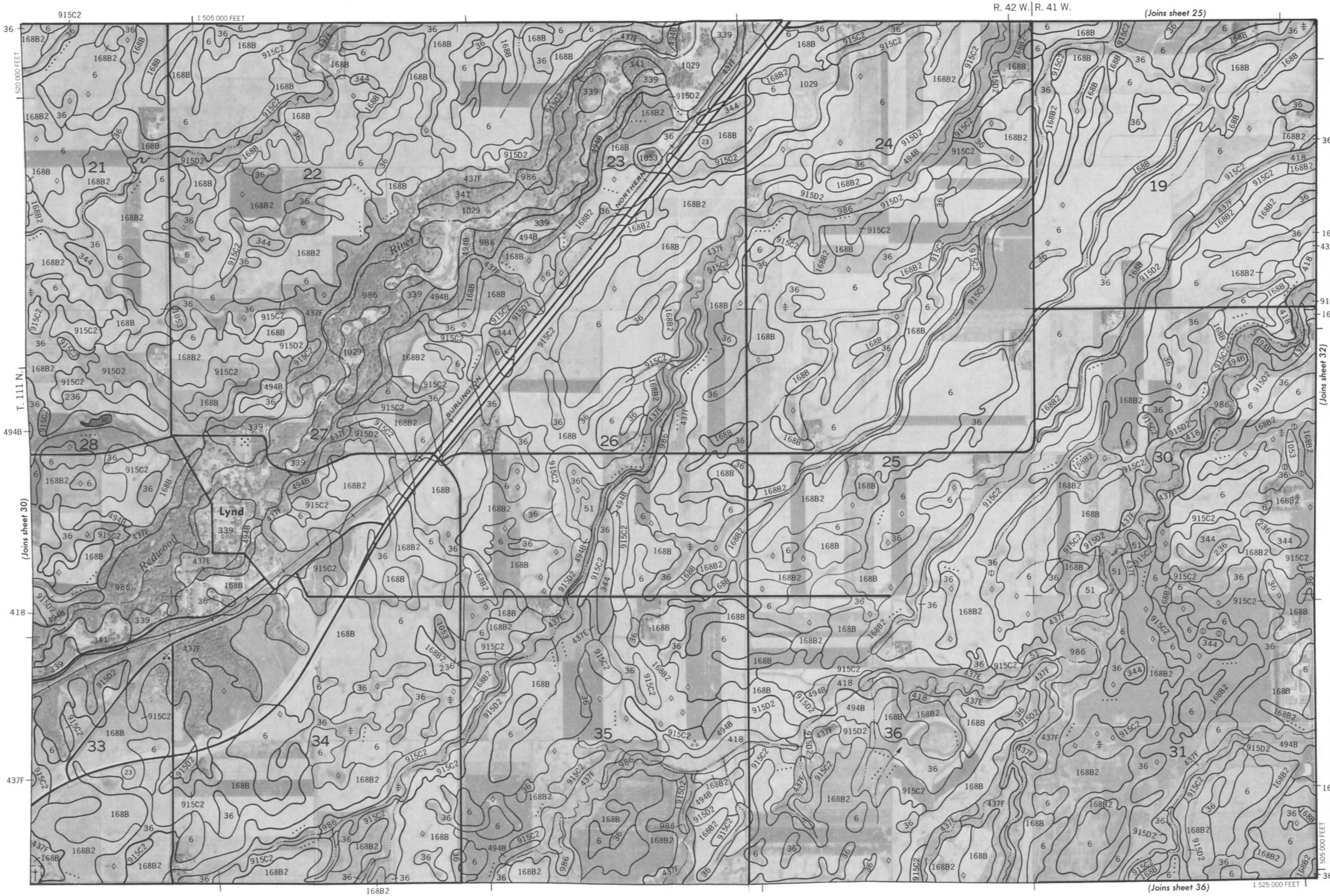

(Joins sheet 28)
R. 40 W.
1 580 000 FEET
515 000 FEET
(Joins sheet 33)
23
24
26
25
35
36
T. 111 N.
REDWOOD COUNTY
505 000 FEET
1 575 000 FEET
(Joins sheet 39)

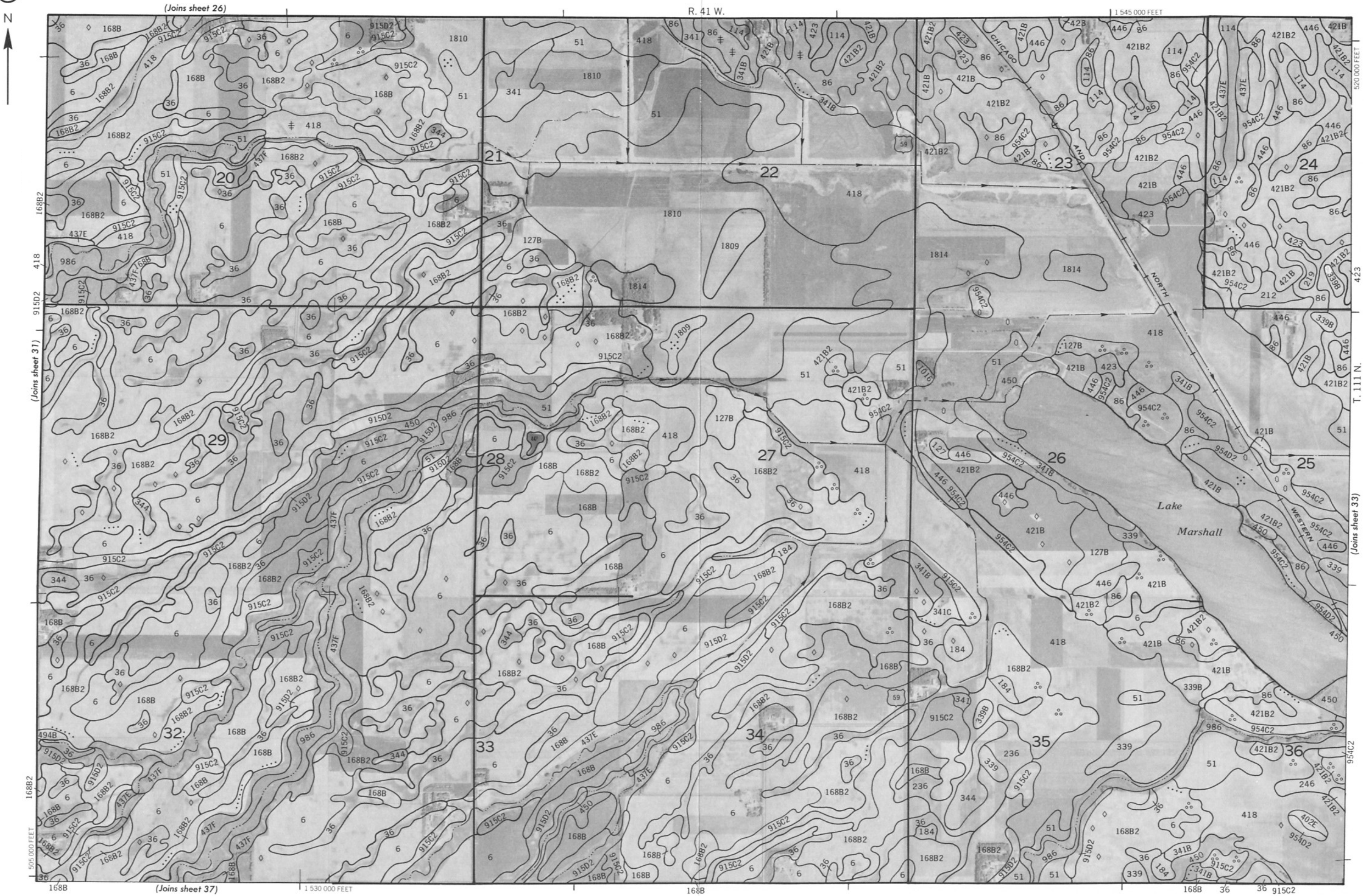


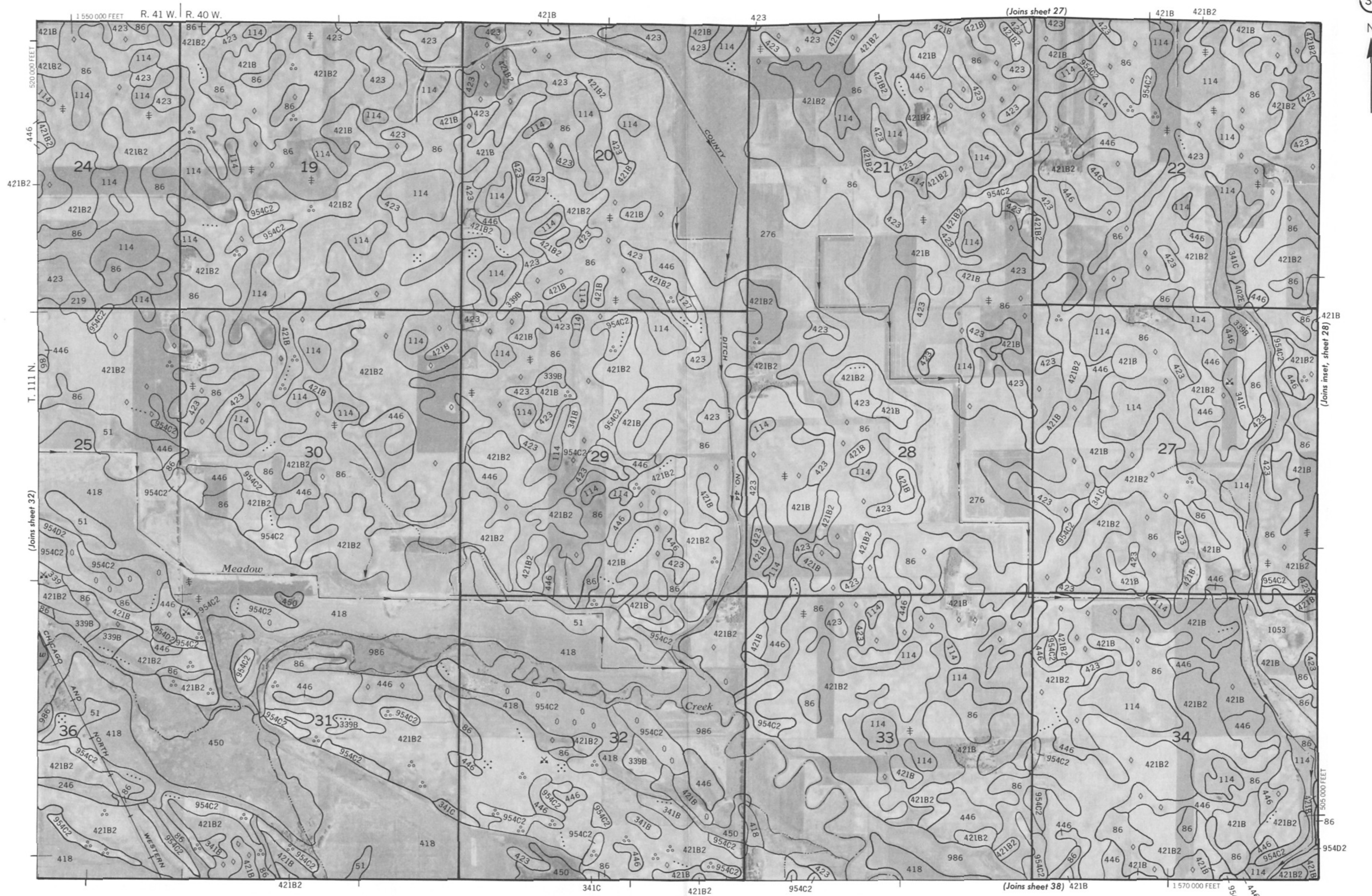
29
N
1 455 000 FEET
520 000 FEET
510 000 FEET
1 475 000 FEET
R. 43 W.
T. 111 N.
(Joins sheet 23)
(Joins sheet 30)
(Joins sheet 34)
LINCOLN COUNTY
Threemile Creek
Goose Lake
Island Lake
19
20
21
22
27
28
29
30
31
32
33

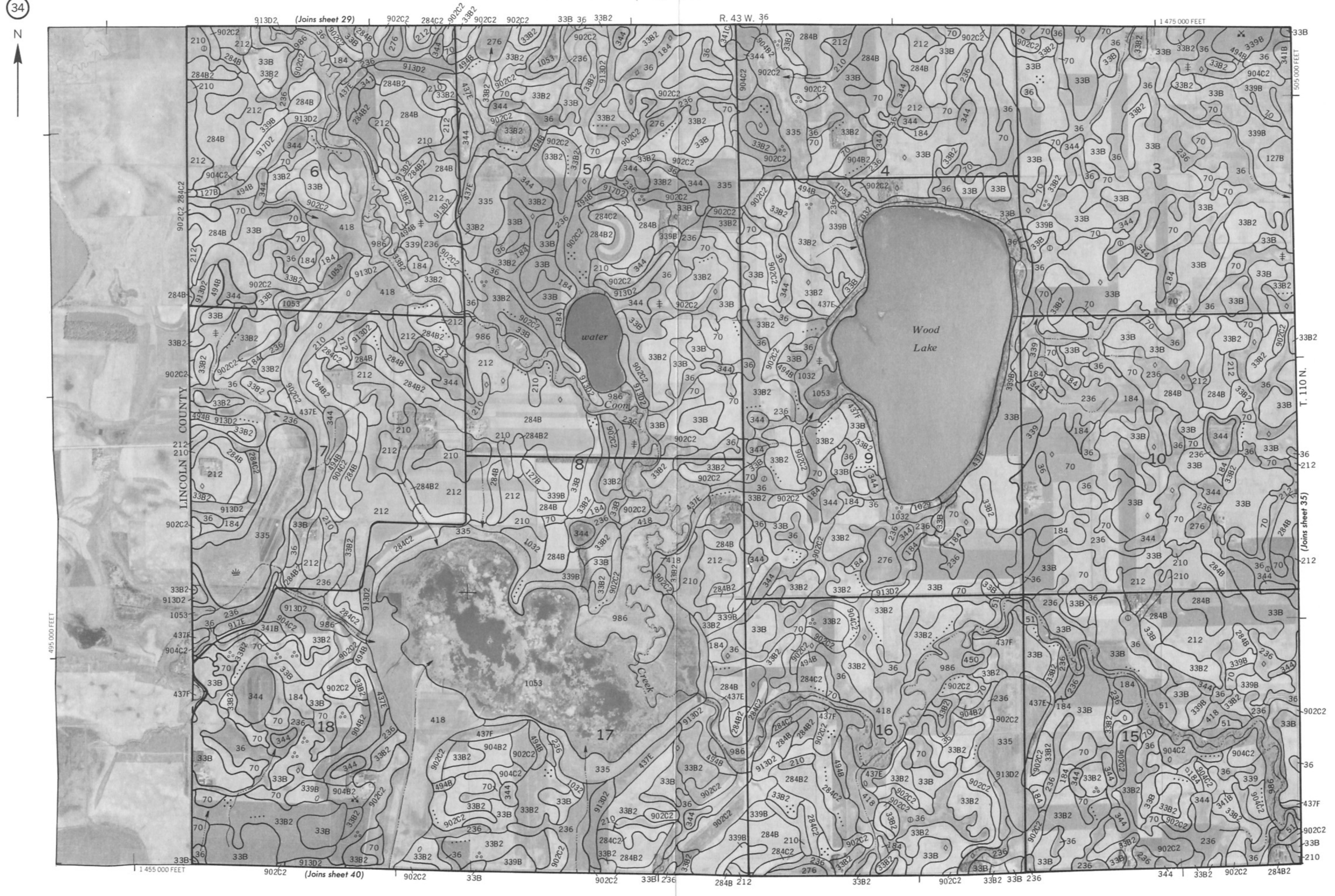
LYON COUNTY, MINNESOTA — SHEET NUMBER 30

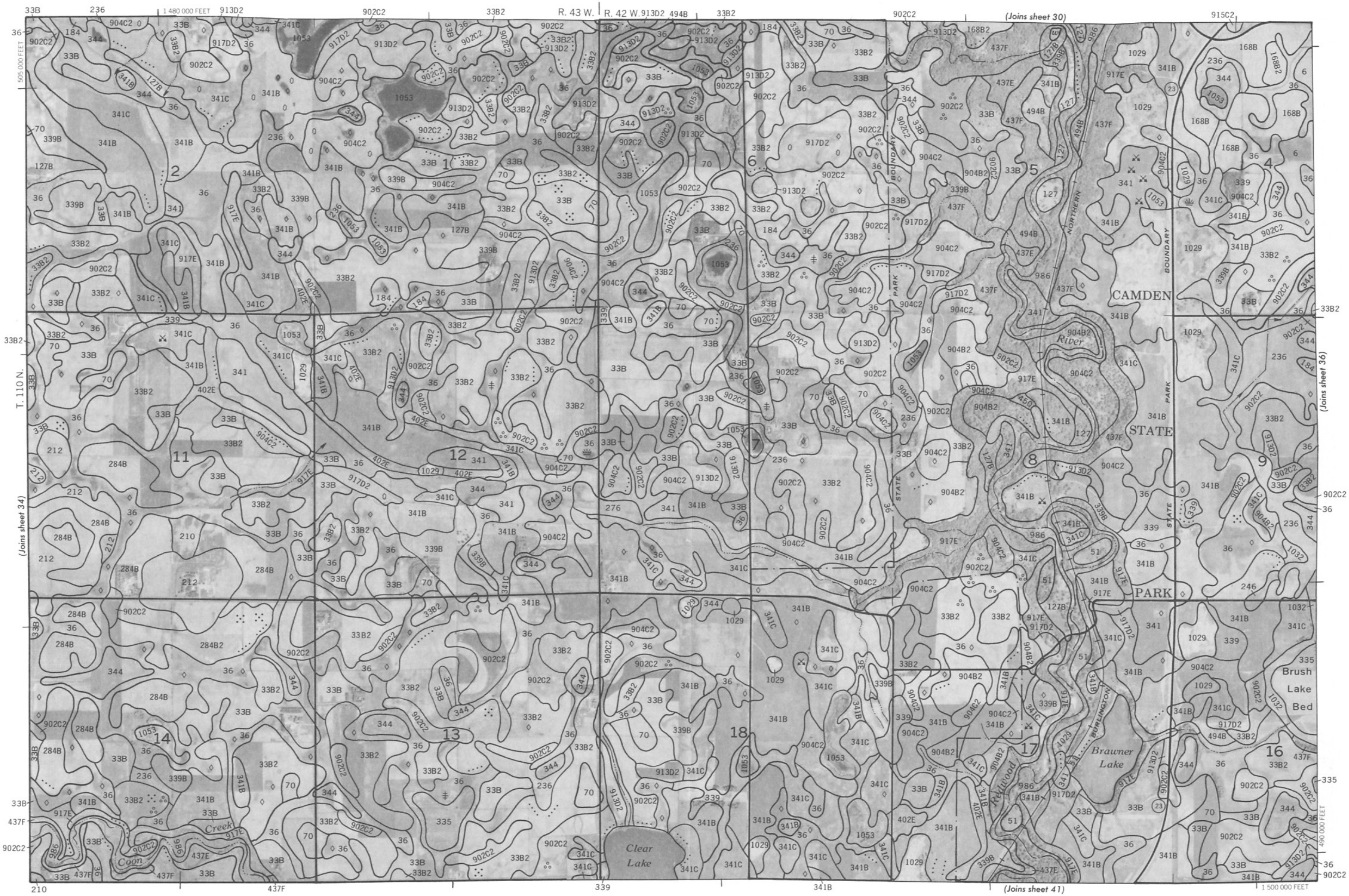


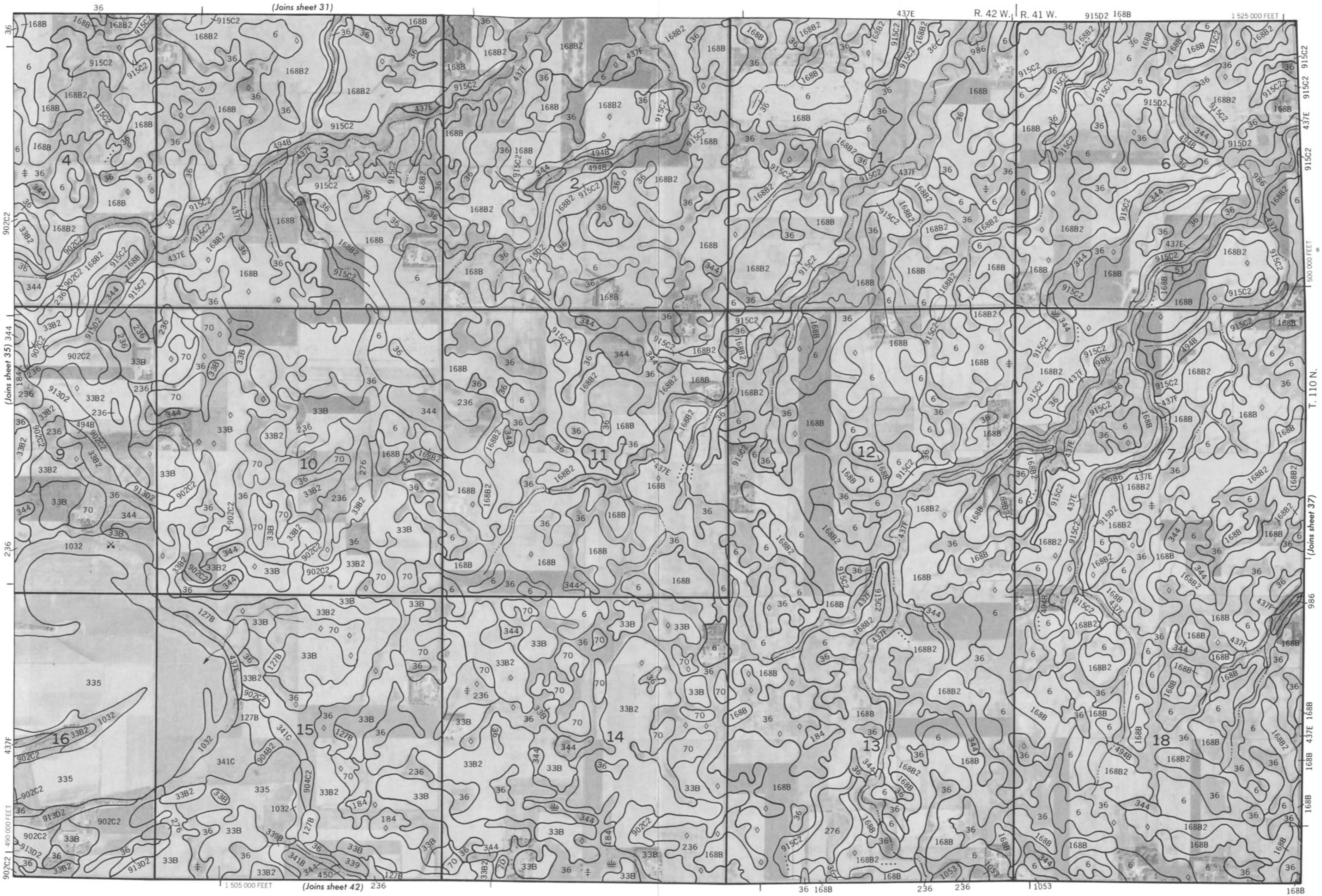

N
1 505 000 FEET
520 000 FEET
R. 42 W.
R. 41 W.
(Joins sheet 25)
(Joins sheet 30)
(Joins sheet 32)
(Joins sheet 36)
T. 111 N.
505 000 FEET
1 525 000 FEET
Lynd
Redwood
River
NORTHERN
BURLINGTON
19
21
22
23
24
25
26
27
28
30
31
33
34
35
36

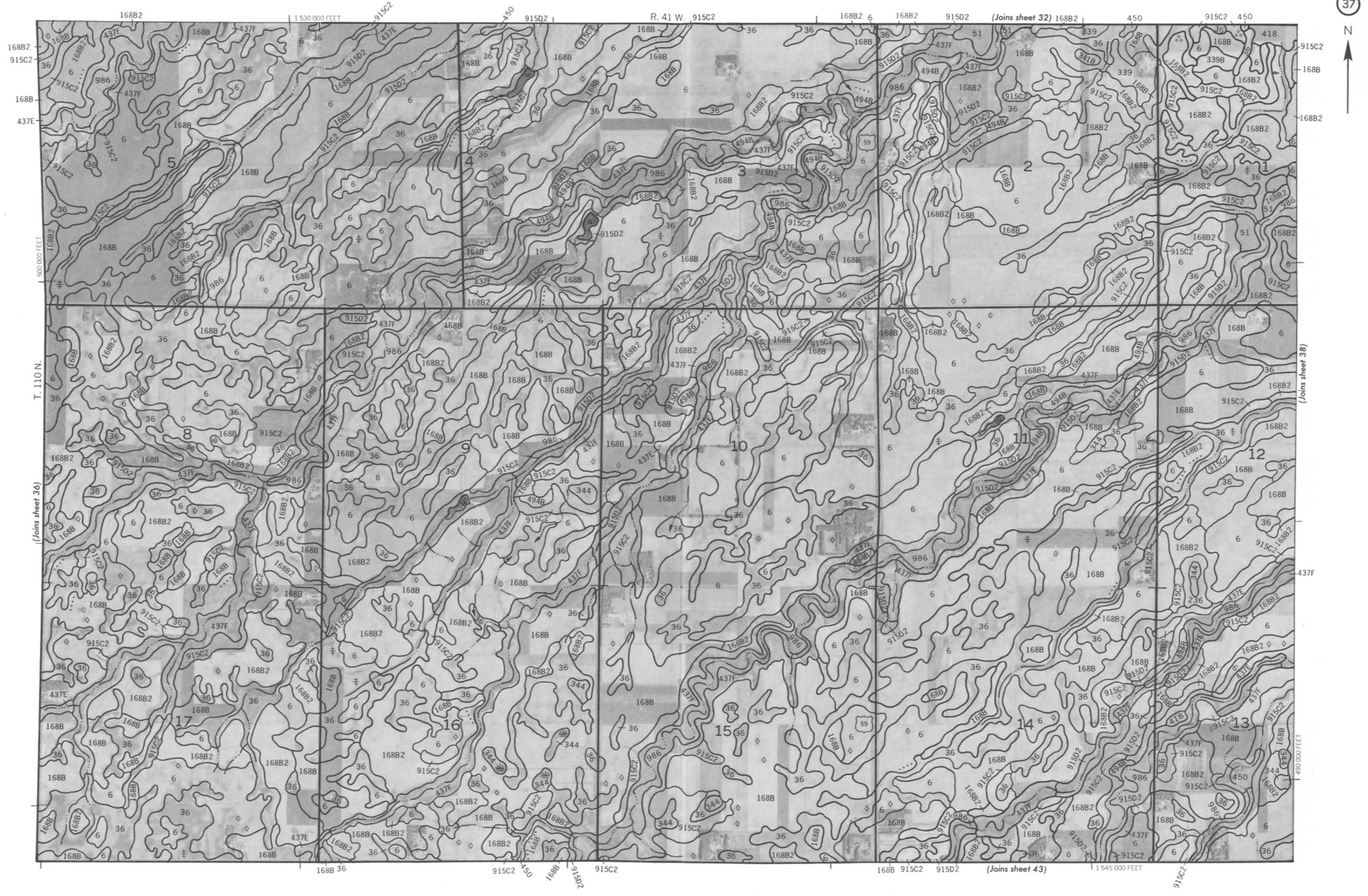

N
(Joins sheet 26)
R. 41 W.
1 545 000 FEET
520 000 FEET
(Joins sheet 31)
(Joins sheet 33)
T. 111 N.
(Joins sheet 37)
1 530 000 FEET
505 000 FEET
Lake
Marshall
CHICAGO
AND
NORTH
WESTERN
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36

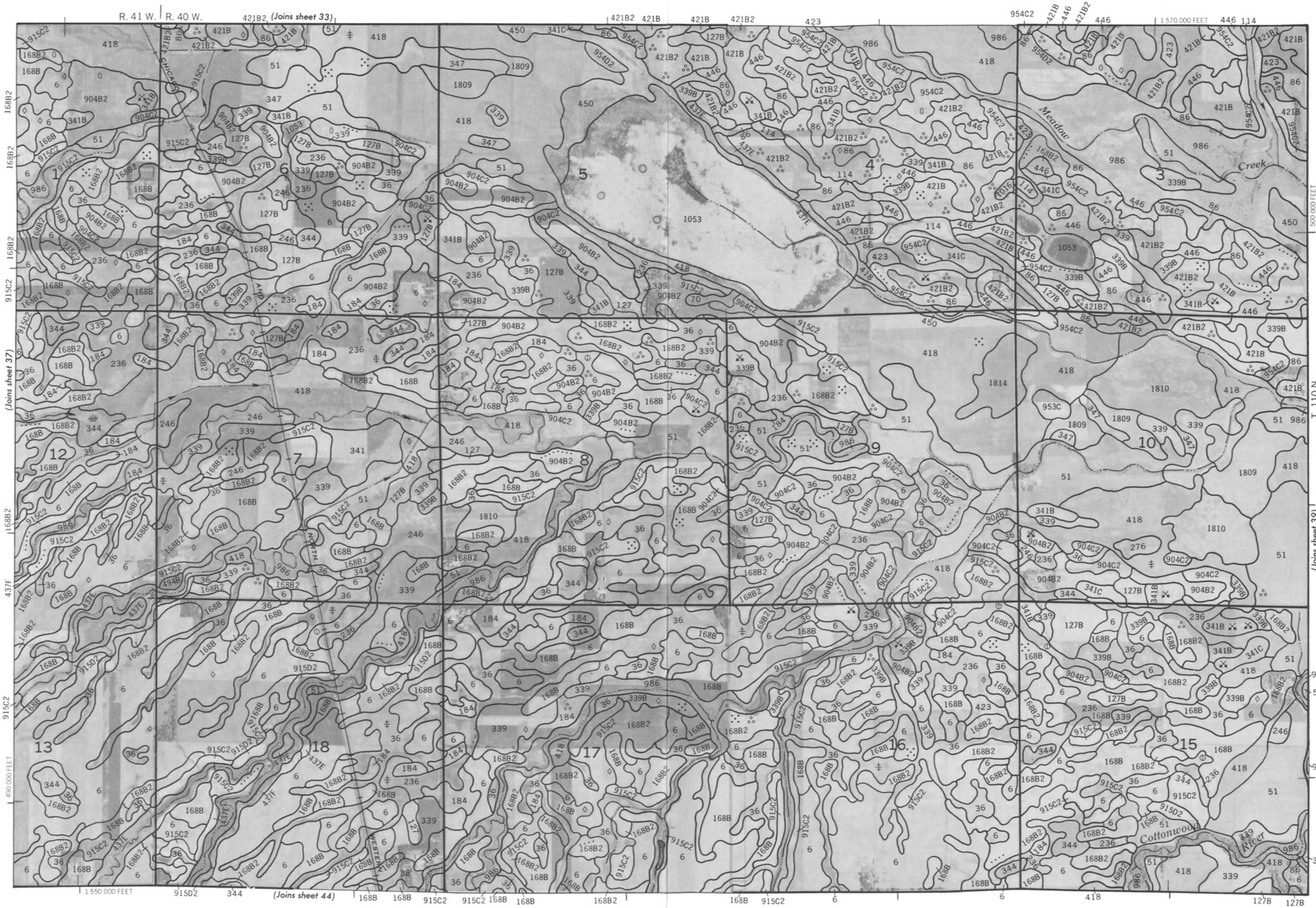

33
N
(Joins sheet 27)
(Joins sheet 32)
(Joins inset, sheet 28)
(Joins sheet 38)
R. 41 W.
R. 40 W.
T. 111 N.
1 550 000 FEET
520 000 FEET
505 000 FEET
1 570 000 FEET
Meadow
Creek
COUNTY
DITCH
NO. 44
CHICAGO
AND
NORTH
WESTERN
19
20
21
22
24
25
27
28
29
30
31
32
33
34
36

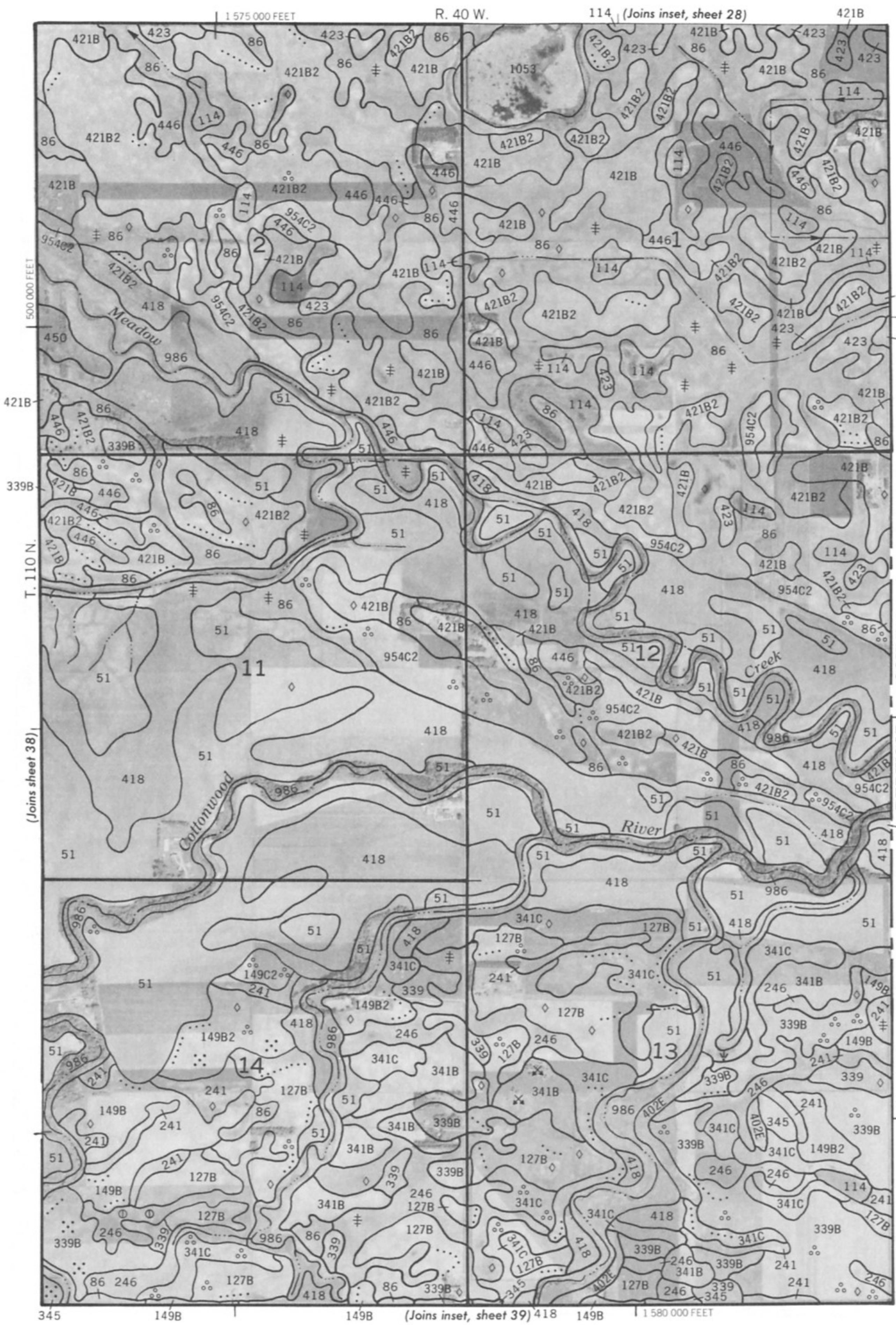

34
N
(Joins sheet 29)
(Joins sheet 35)
(Joins sheet 40)
R. 43 W.
T. 110 N.
1 475 000 FEET
505 000 FEET
495 000 FEET
1 455 000 FEET
LINCOLN COUNTY
Wood Lake
water
Coon Creek

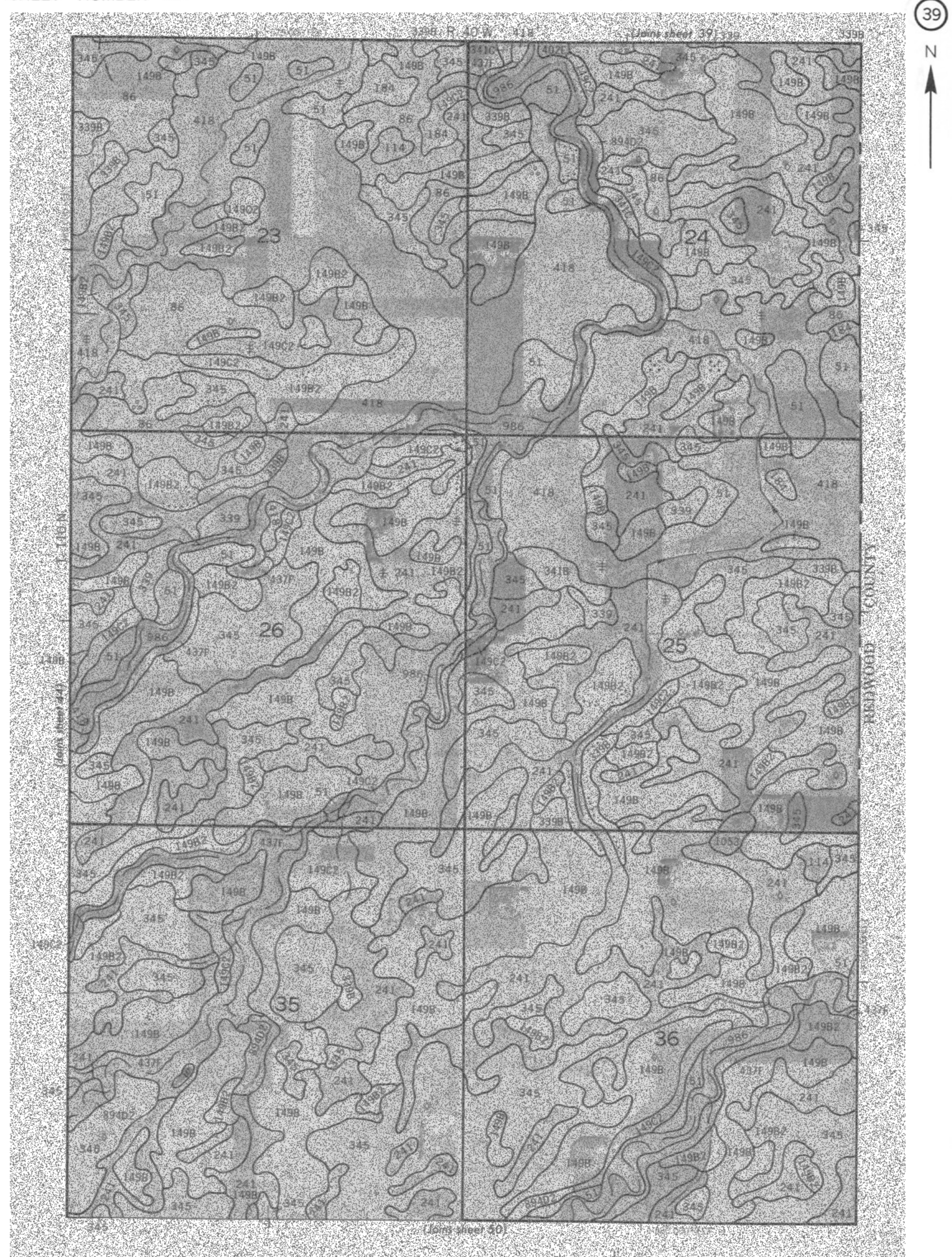

N
1 480 000 FEET
R. 43 W.
R. 42 W.
(Joins sheet 30)
505 000 FEET
T. 110 N.
(Joins sheet 34)
(Joins sheet 36)
(Joins sheet 41)
CAMDEN
STATE
PARK
STATE PARK BOUNDARY
NORTHERN
River
Redwood
BURLINGTON
Brawner
Lake
Brush
Lake
Bed
Clear
Lake
Coon
Creek
490 000 FEET
1 500 000 FEET

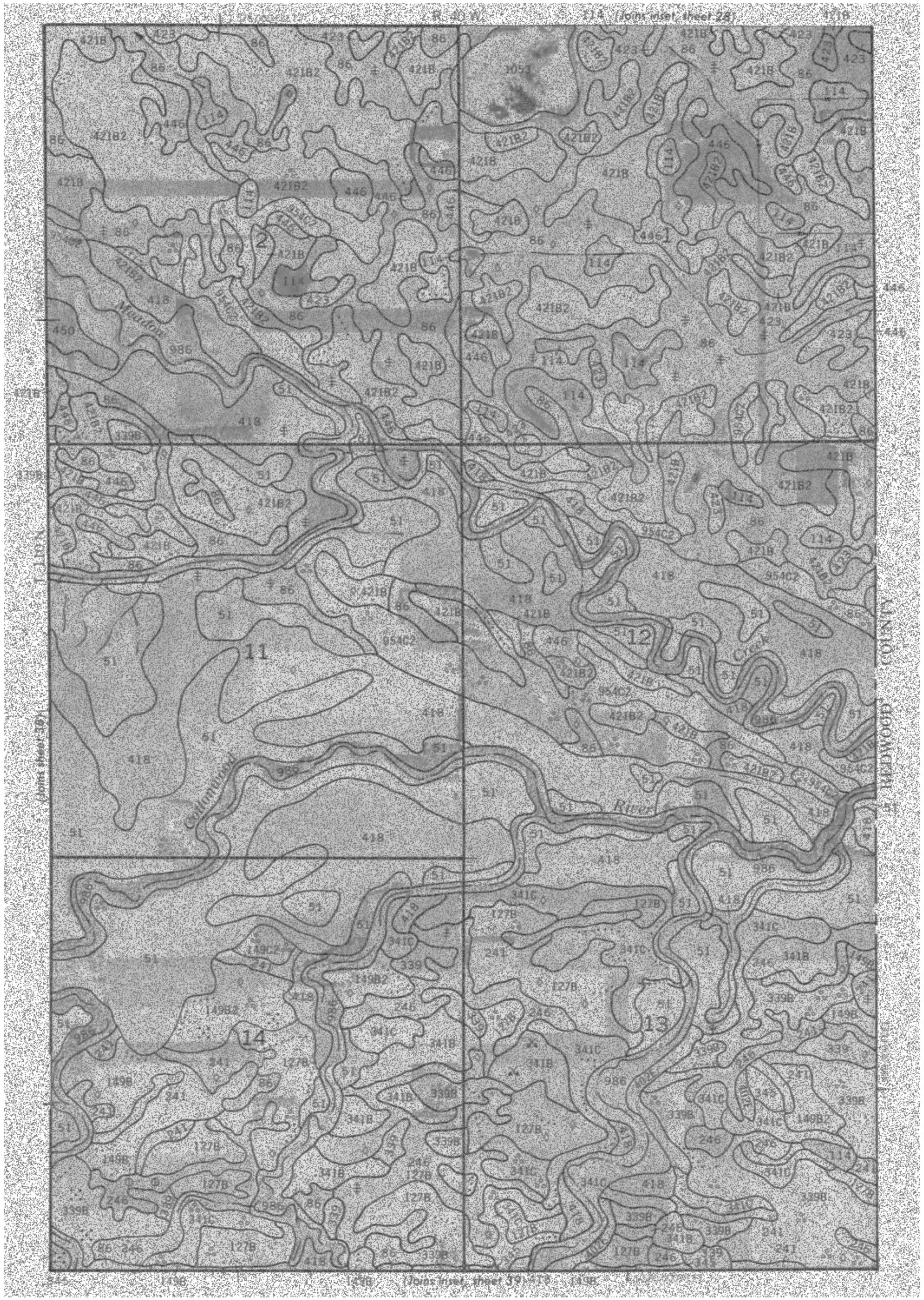

N
(Joins sheet 31)
(Joins sheet 35)
(Joins sheet 37)
(Joins sheet 42)
R. 42 W.
R. 41 W.
T. 110 N.
1 525 000 FEET
500 000 FEET
1 505 000 FEET
490 000 FEET

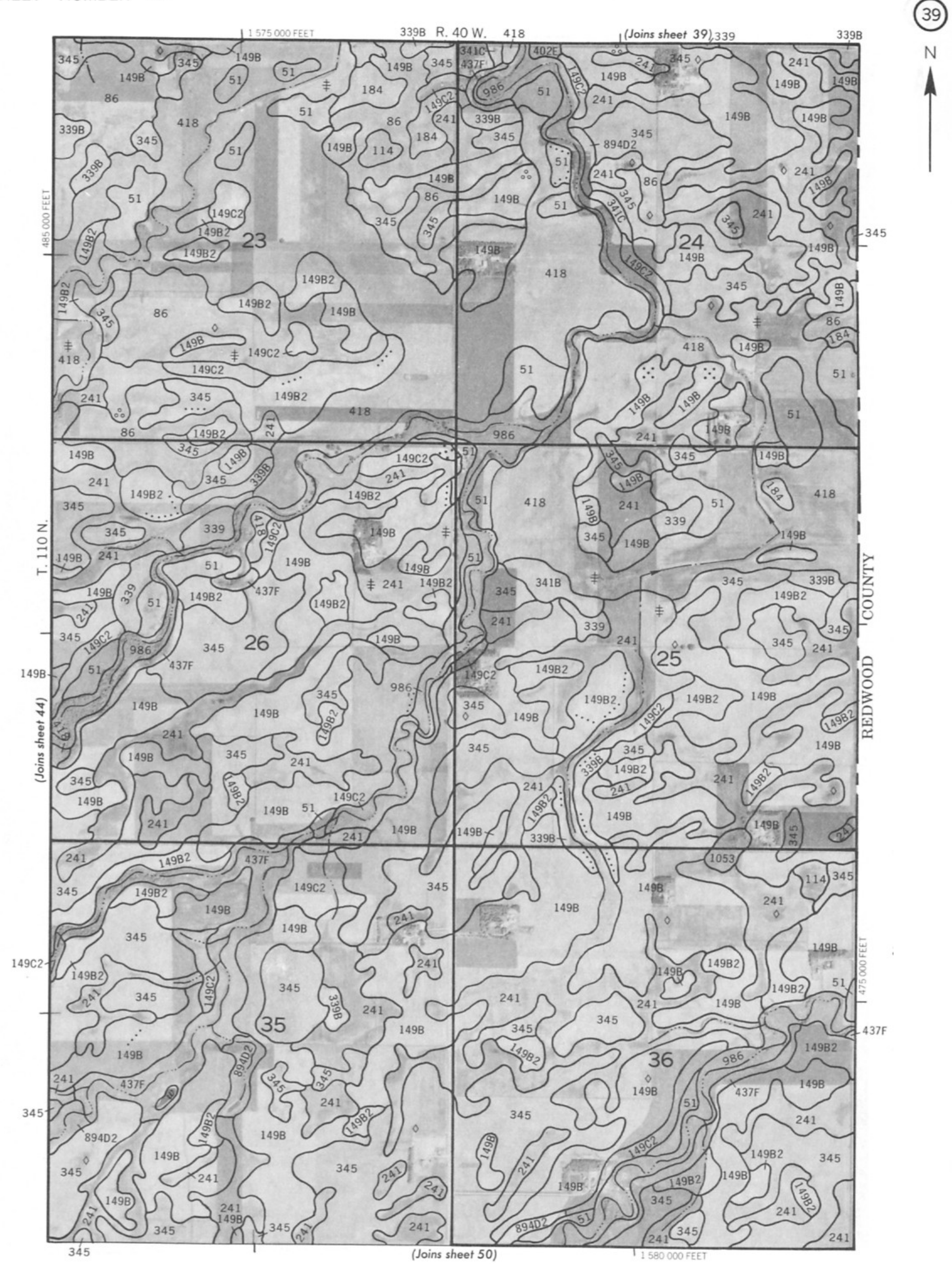

37
N
R. 41 W.
T. 110 N.
(Joins sheet 32)
(Joins sheet 36)
(Joins sheet 38)
(Joins sheet 43)
1 530 000 FEET
1 545 000 FEET
500 000 FEET
490 000 FEET


N
R. 41 W.
R. 40 W.
(Joins sheet 33)
(Joins sheet 37)
(Joins sheet 39)
(Joins sheet 44)
T. 110 N.
1 570 000 FEET
500 000 FEET
1 550 000 FEET
490 000 FEET
Meadow Creek
Cottonwood River
CHICAGO AND NORTH WESTERN

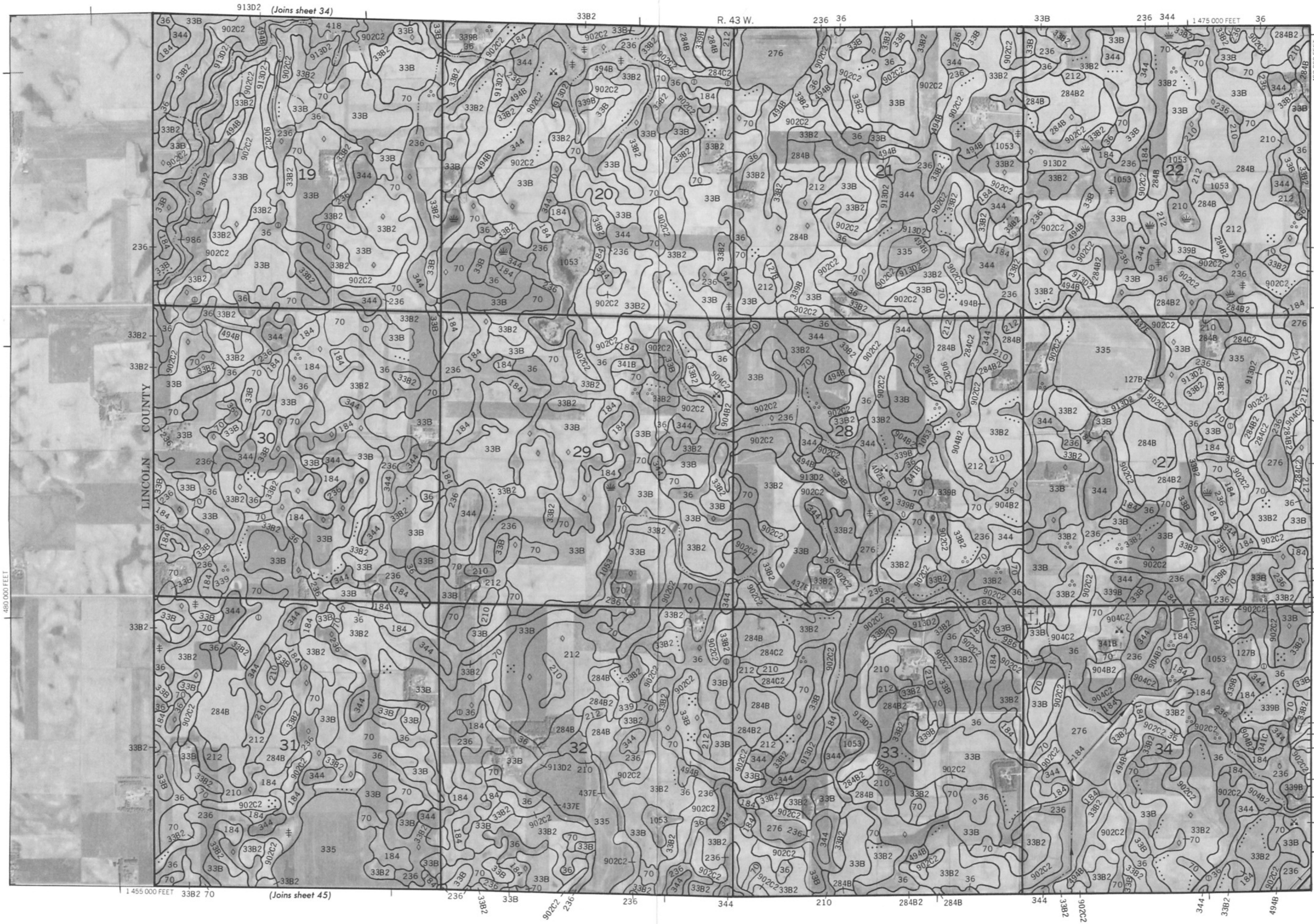

1 575 000 FEET
R. 40 W.
114 (Joins inset, sheet 28)
500 000 FEET
T. 110 N.
(Joins sheet 38)
Meadow
Creek
Cottonwood
River
REDWOOD COUNTY
490 000 FEET
1 580 000 FEET
(Joins inset, sheet 39)
1
2
11
12
13
14


39
N
R. 40 W.
(Joins sheet 39)
T. 110 N.
(Joins sheet 44)
REDWOOD COUNTY
(Joins sheet 50)
23
24
25
26
35
36


R. 40 W.
(Joins inset, sheet 28)
(Joins sheet 38)
(Joins inset, sheet 39)
REDWOOD COUNTY
Cottonwood
River
Meadow
Creek
11
12
13
14

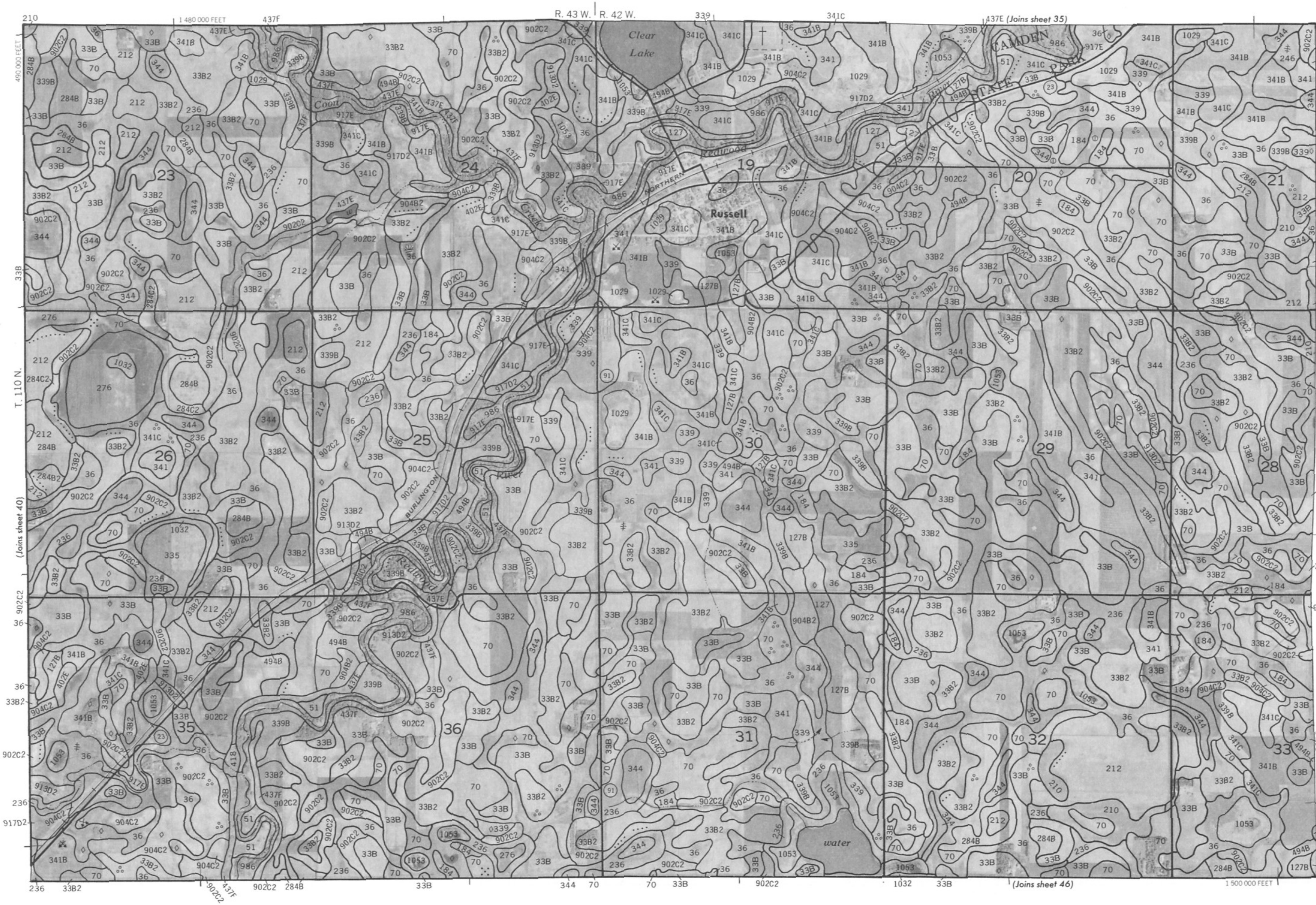

39
N
1 575 000 FEET
R. 40 W.
(Joins sheet 39)
485 000 FEET
T. 110 N.
(Joins sheet 44)
(Joins sheet 50)
1 580 000 FEET
475 000 FEET
REDWOOD
COUNTY
23
24
25
26
35
36

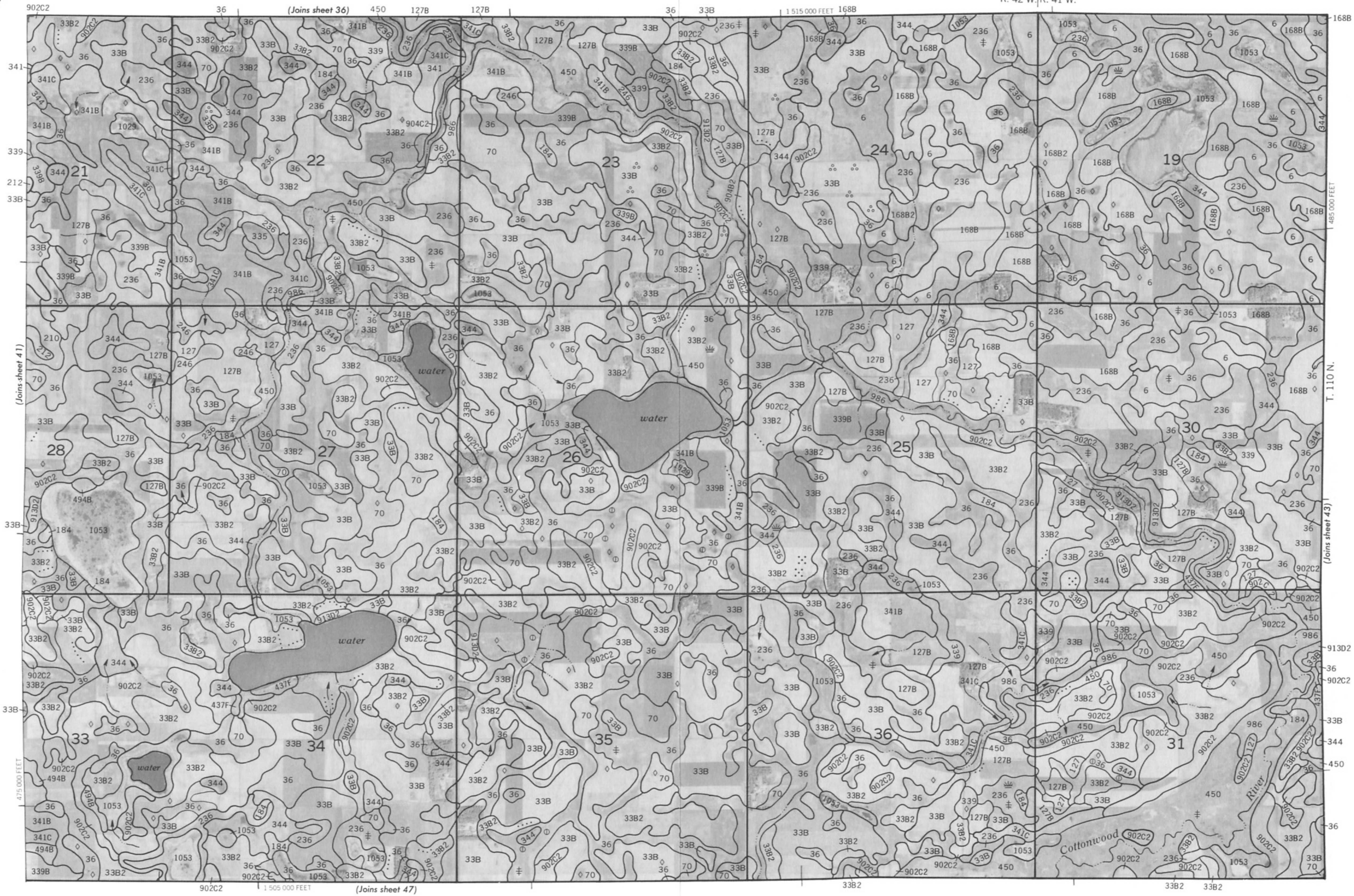
LYON COUNTY, MINNESOTA — SHEET NUMBER 40

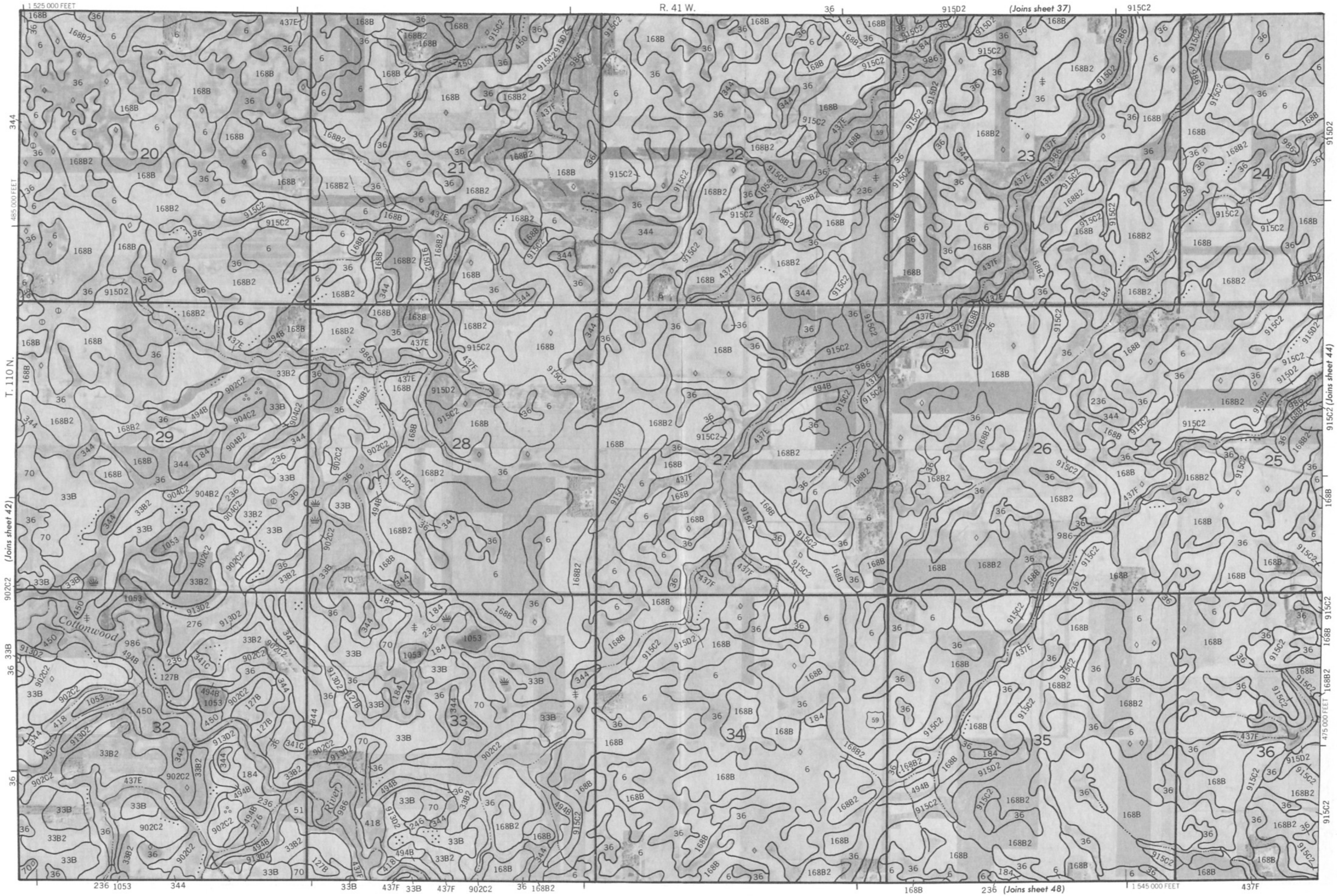


LYON COUNTY, MINNESOTA — SHEET NUMBER 41

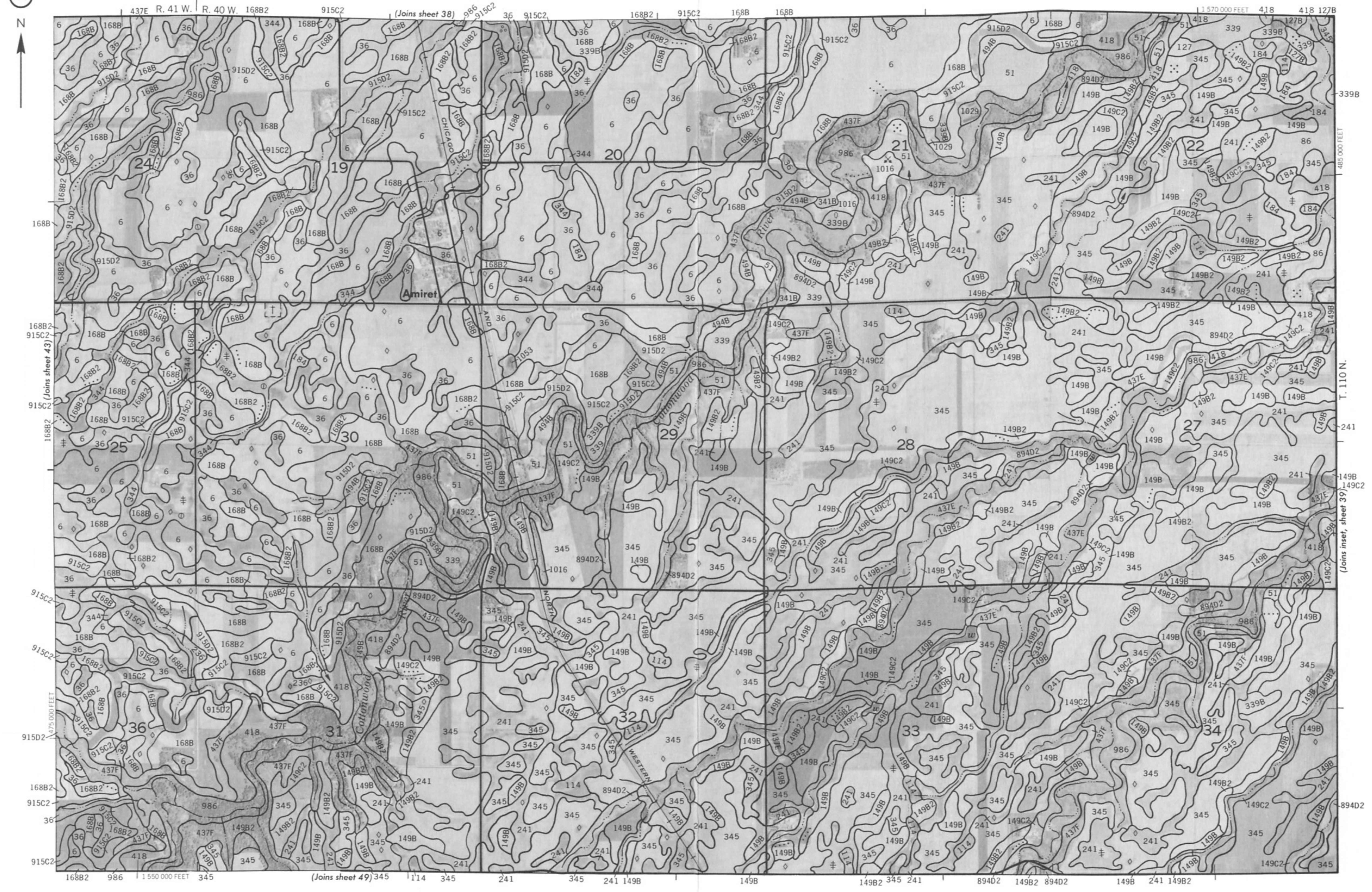
41

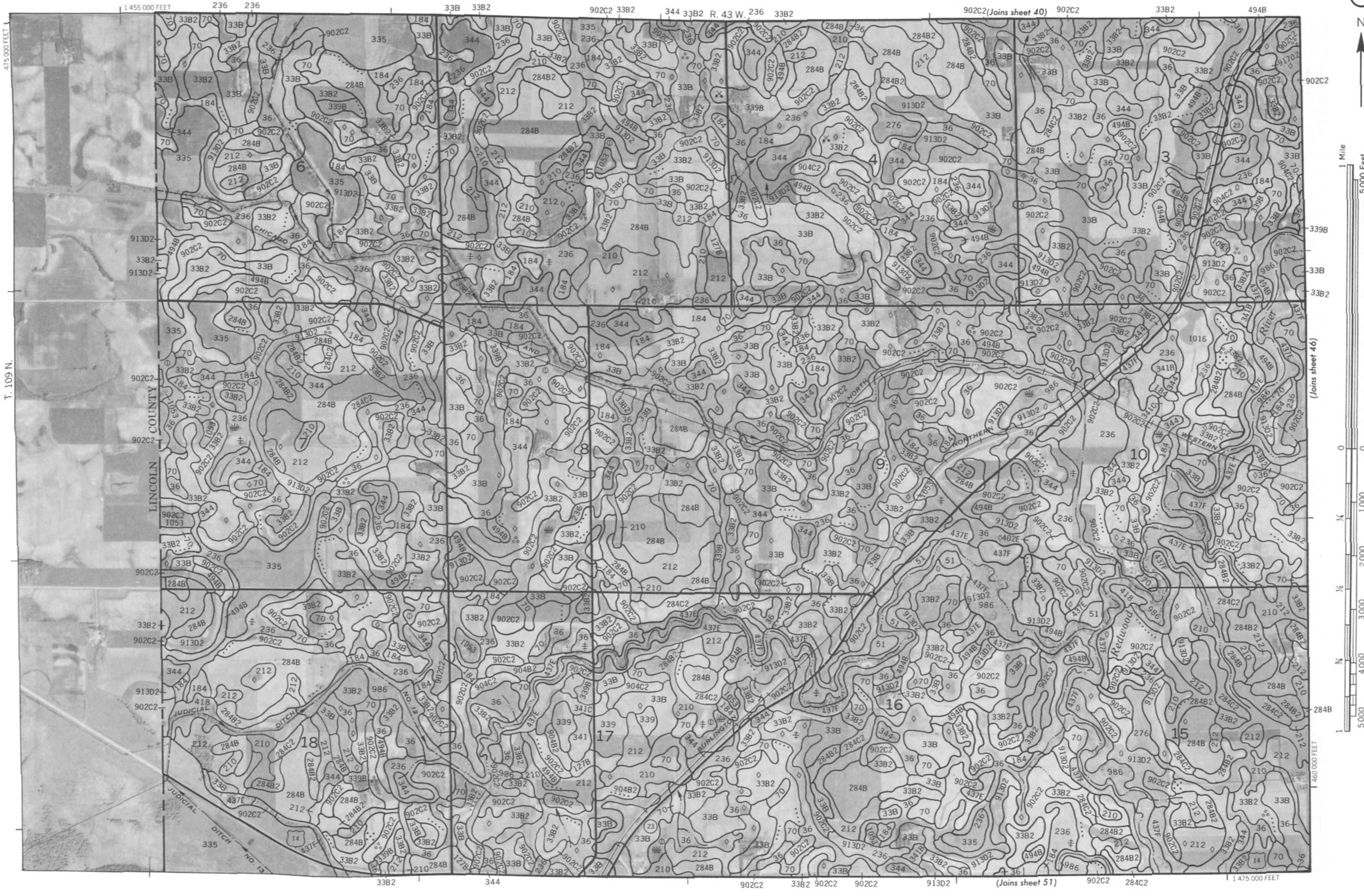



N
(Joins sheet 36)
R. 42 W.
R. 41 W.
1 515 000 FEET
485 000 FEET
T. 110 N.
(Joins sheet 41)
(Joins sheet 43)
475 000 FEET
1 505 000 FEET
(Joins sheet 47)
21
22
23
24
19
28
27
26
25
30
33
34
35
36
31
water
water
water
water
Cottonwood
River

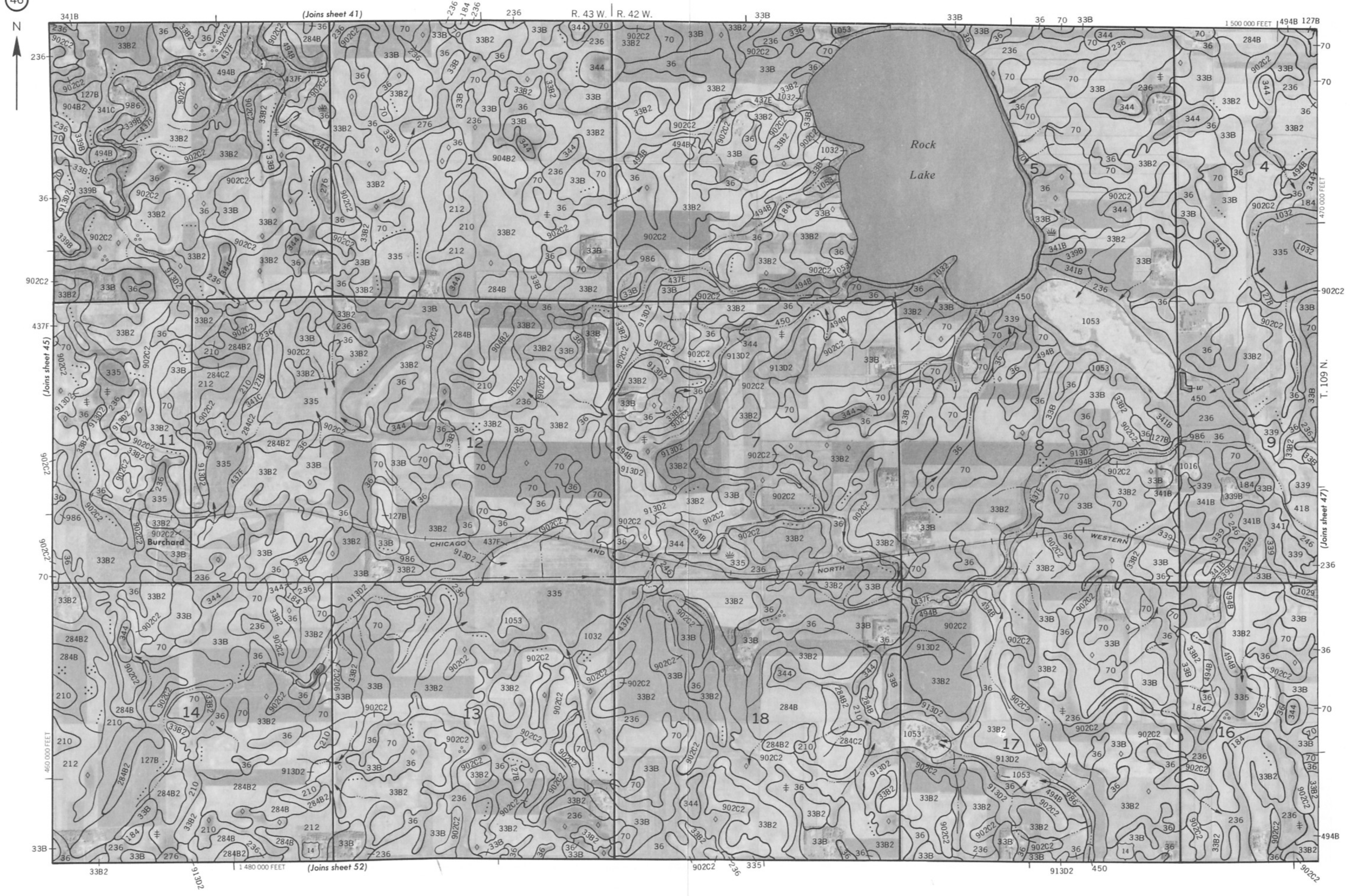

N
1 525 000 FEET
R. 41 W.
(Joins sheet 37)
(Joins sheet 44)
(Joins sheet 48)
(Joins sheet 42)
T. 110 N.
485 000 FEET
475 000 FEET
1 545 000 FEET
Cottonwood
River
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36

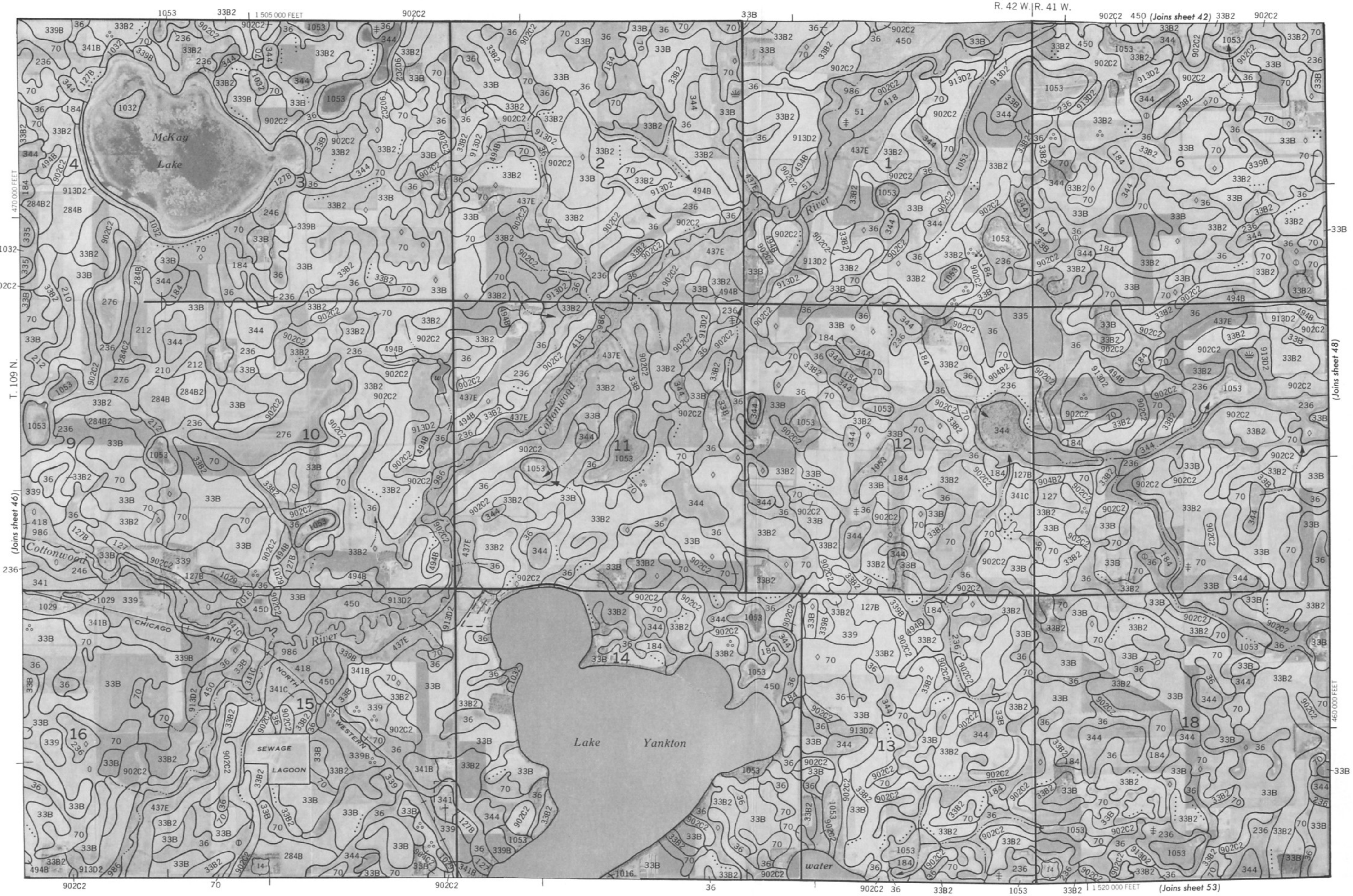
44

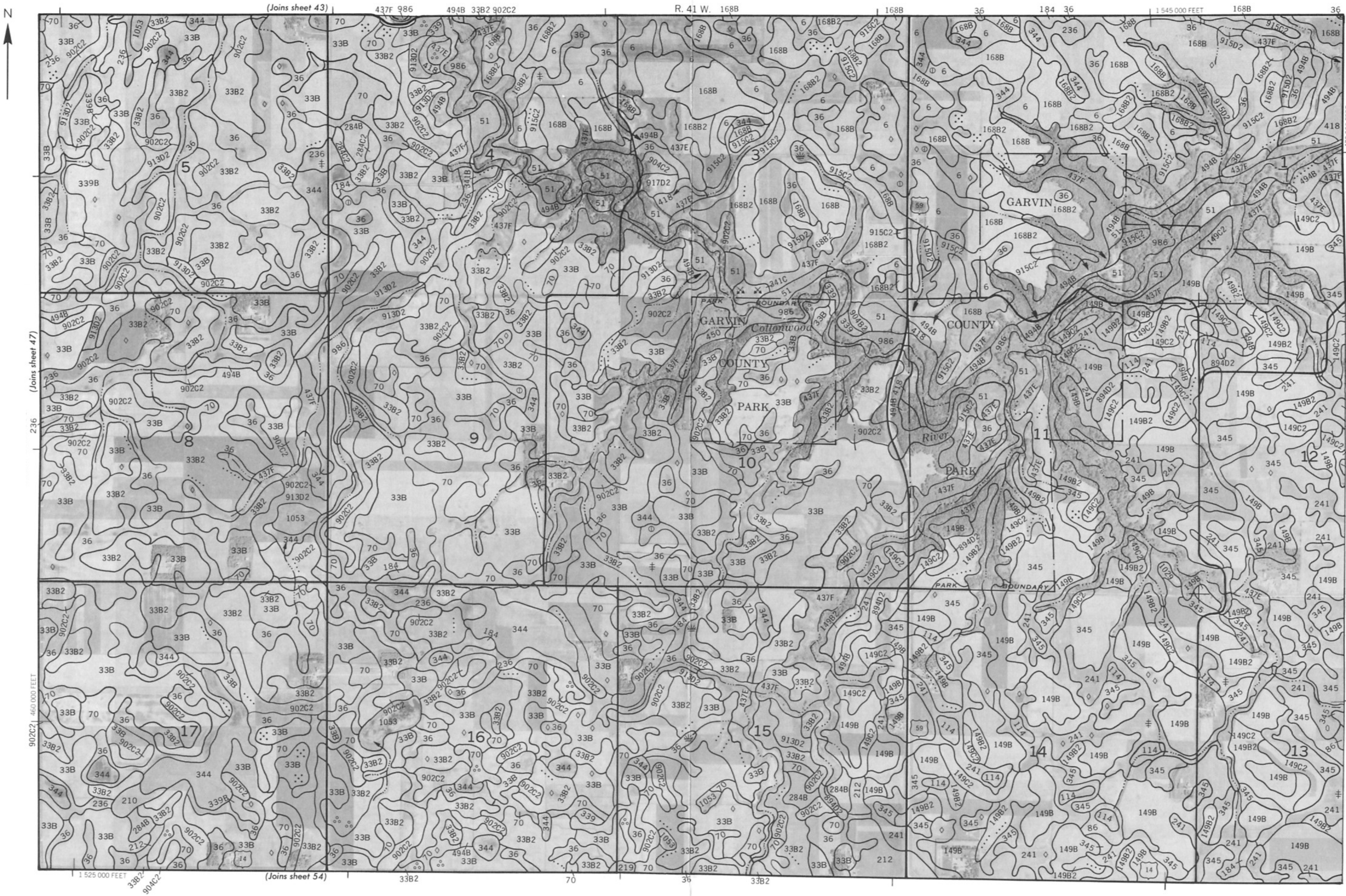

N
R. 41 W.
R. 40 W.
(Joins sheet 38)
(Joins sheet 43)
(Joins sheet 49)
(Joins inset, sheet 39)
T. 110 N.
1 570 000 FEET
485 000 FEET
475 000 FEET
1 550 000 FEET
Amiret
Cottonwood River
Cottonwood
CHICAGO AND NORTH WESTERN
19
20
21
22
24
25
27
28
29
30
31
32
33
34
36

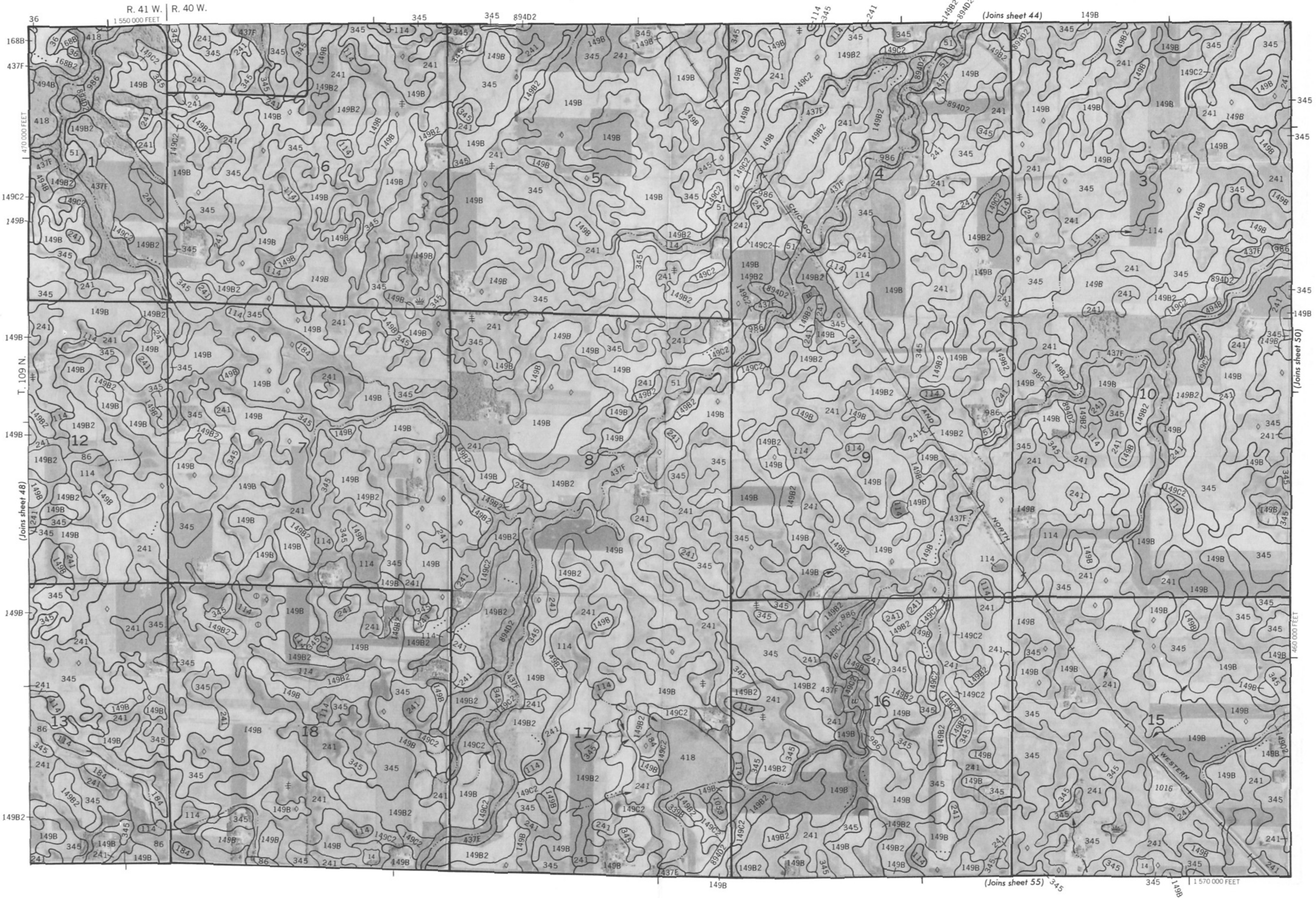

1 455 000 FEET
475 000 FEET
R. 43 W.
T. 109 N.
(Joins sheet 40)
(Joins sheet 46)
(Joins sheet 51)
LINCOLN COUNTY
CHICAGO
AND
NORTH
WESTERN
NORTHERN
BURLINGTON
JUDICIAL DITCH NO. 12
JUDICIAL DITCH NO. 13
Redwood
River
1 475 000 FEET
460 000 FEET
N
1 Mile
5000 Feet
Scale 1:20000

LYON COUNTY, MINNESOTA — SHEET NUMBER 46

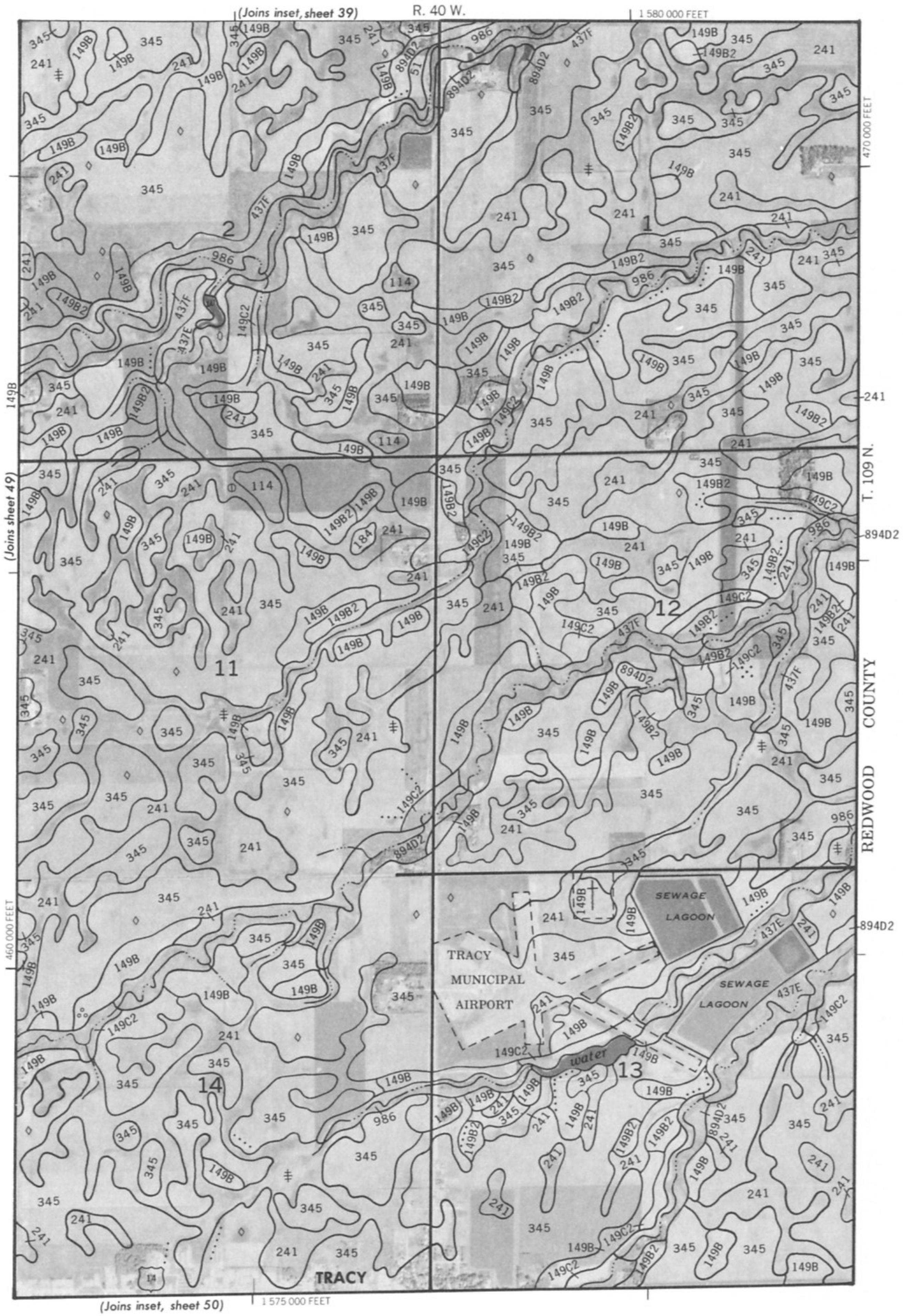


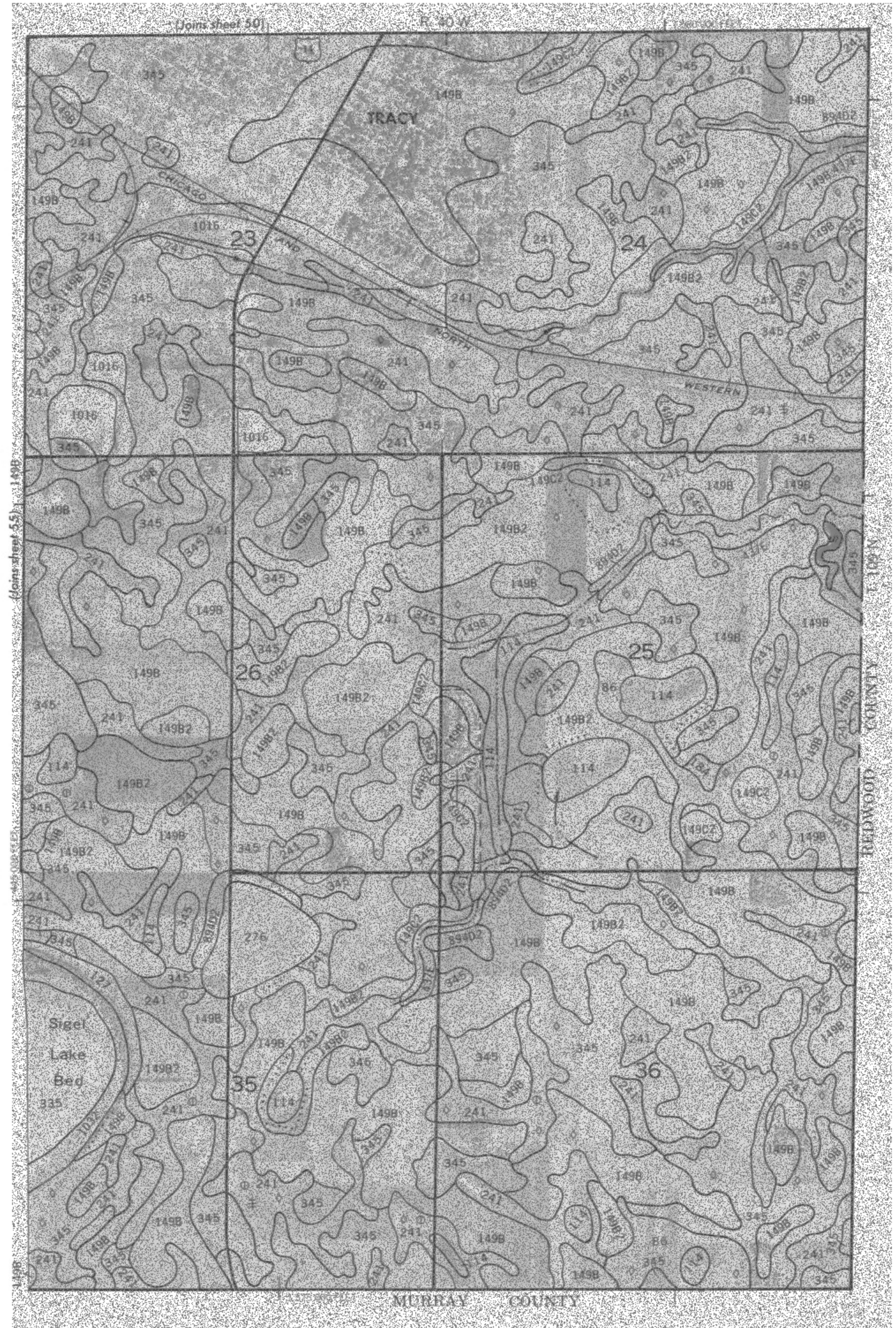

N
R. 42 W. | R. 41 W.
1 505 000 FEET
1 520 000 FEET
470 000 FEET
460 000 FEET
T. 109 N.
(Joins sheet 42)
(Joins sheet 48)
(Joins sheet 53)
(Joins sheet 46)
McKay Lake
Lake Yankton
Cottonwood River
Cottonwood
River
CHICAGO AND NORTH WESTERN
SEWAGE LAGOON
water
1
2
3
4
6
7
9
10
11
12
13
14
15
16
18


N
(Joins sheet 43)
R. 41 W.
1 545 000 FEET
470 000 FEET
(Joins sheet 47)
(Joins sheet 49)
T. 109 N.
460 000 FEET
1 525 000 FEET
(Joins sheet 54)
GARVIN
GARVIN COUNTY PARK
Cottonwood River
COUNTY PARK
PARK BOUNDARY
1
2
3
4
5
8
9
10
11
12
13
14
15
16
17


N
R. 41 W.
R. 40 W.
1 550 000 FEET
470 000 FEET
T. 109 N.
(Joins sheet 44)
(Joins sheet 48)
(Joins sheet 50)
(Joins sheet 55)
460 000 FEET
1 570 000 FEET
CHICAGO AND NORTH WESTERN
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18

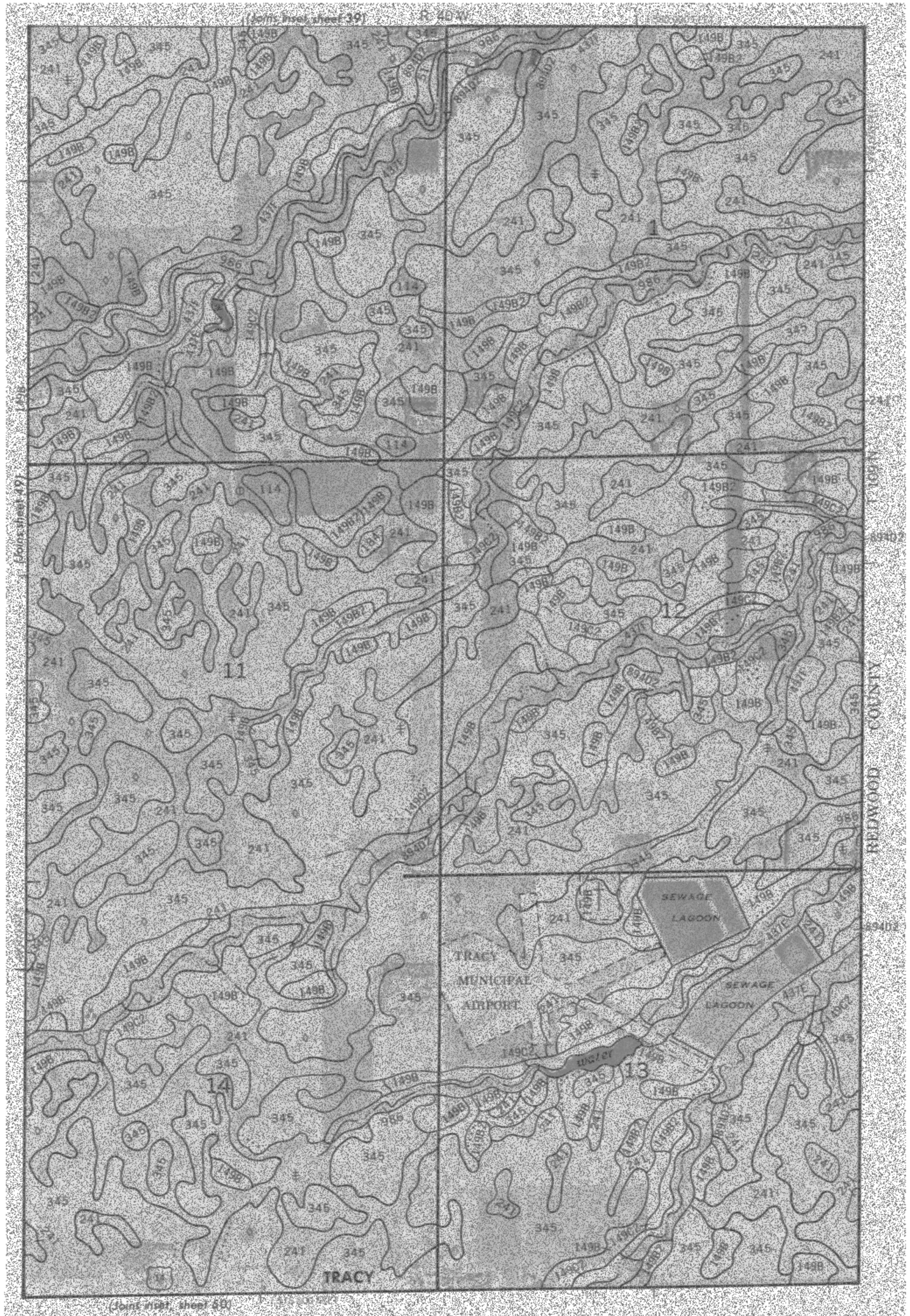
N

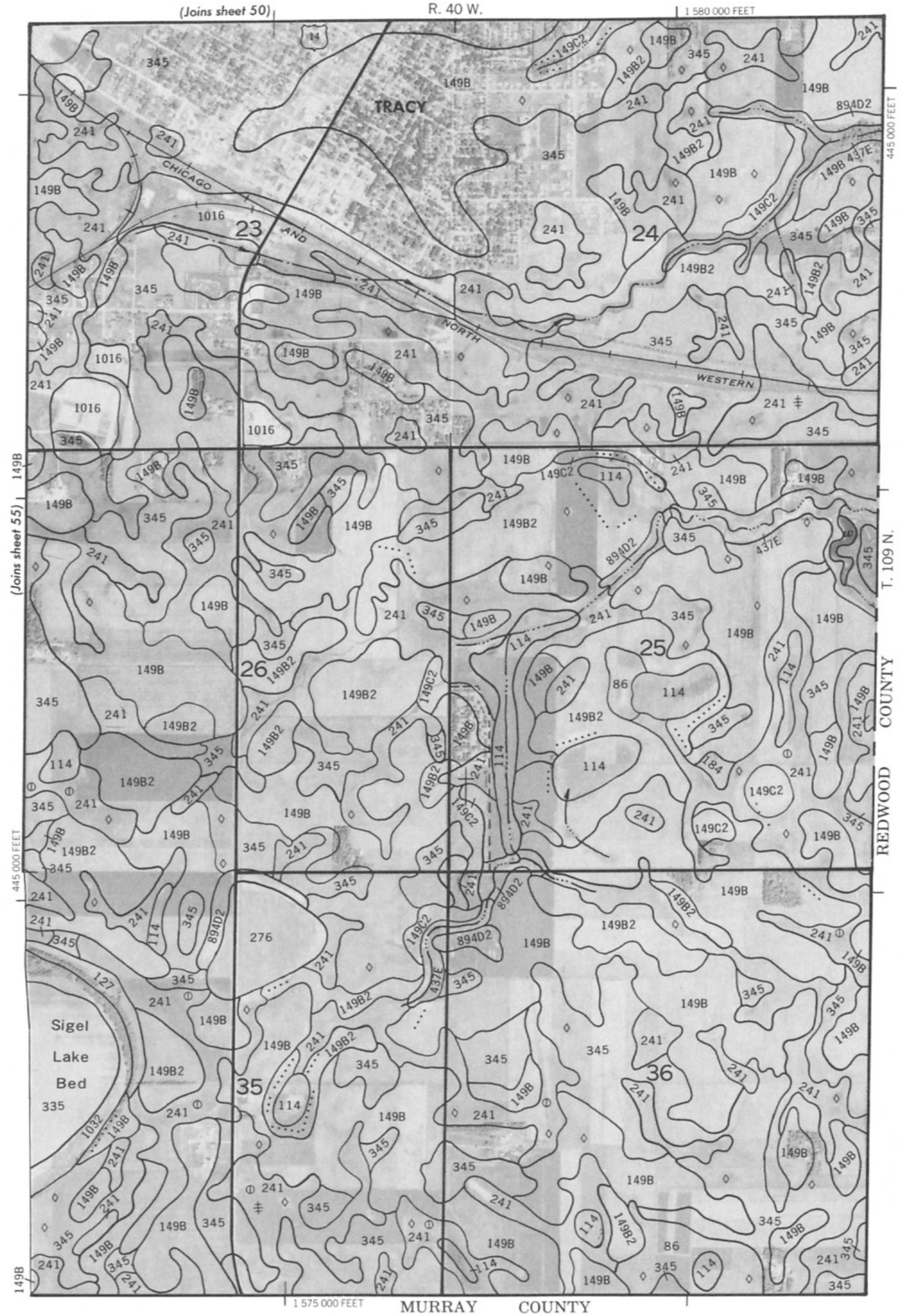

(Joins inset, sheet 39)
R. 40 W.
1 580 000 FEET
470 000 FEET
T. 109 N.
(Joins sheet 49)
REDWOOD COUNTY
460 000 FEET
SEWAGE LAGOON
SEWAGE LAGOON
TRACY MUNICIPAL AIRPORT
water
TRACY
(Joins inset, sheet 50)
1 575 000 FEET
2
1
11
12
14
13

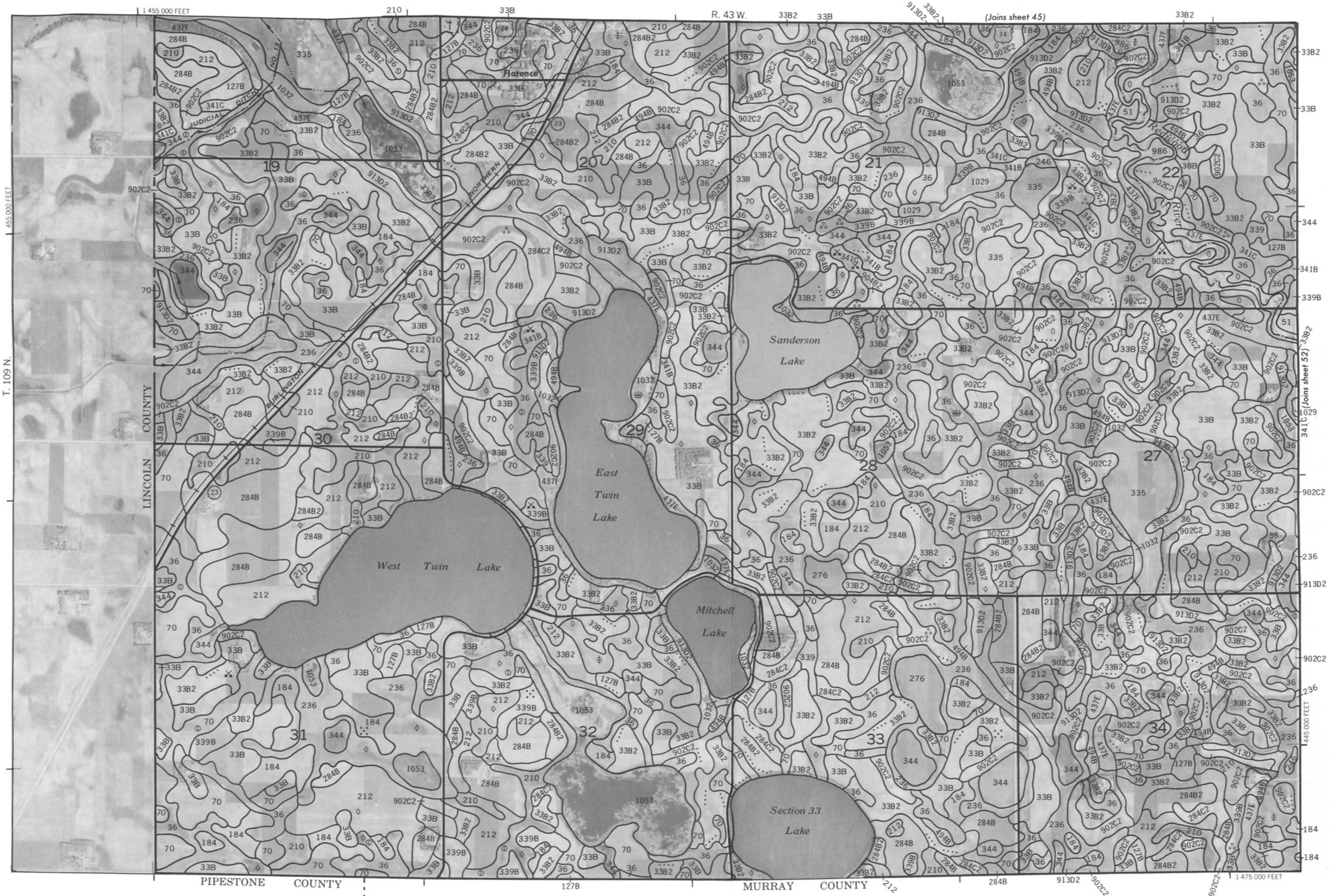

(Joins sheet 50)
R. 40 W.
TRACY
CHICAGO AND NORTH WESTERN
(Joins sheet 55)
REDWOOD COUNTY
Sigel Lake Bed
MURRAY COUNTY
23
24
26
25
35
36

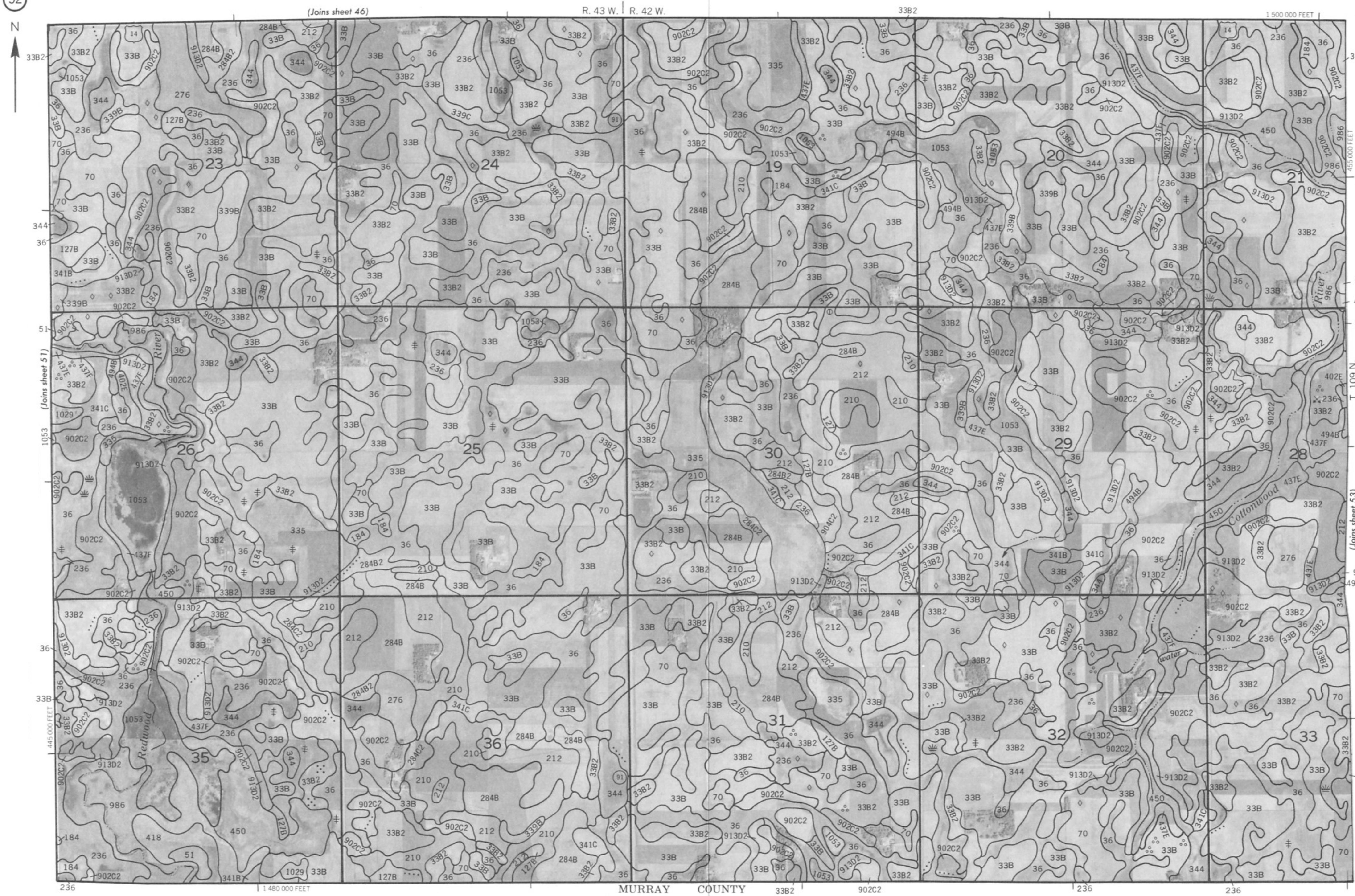
(50)

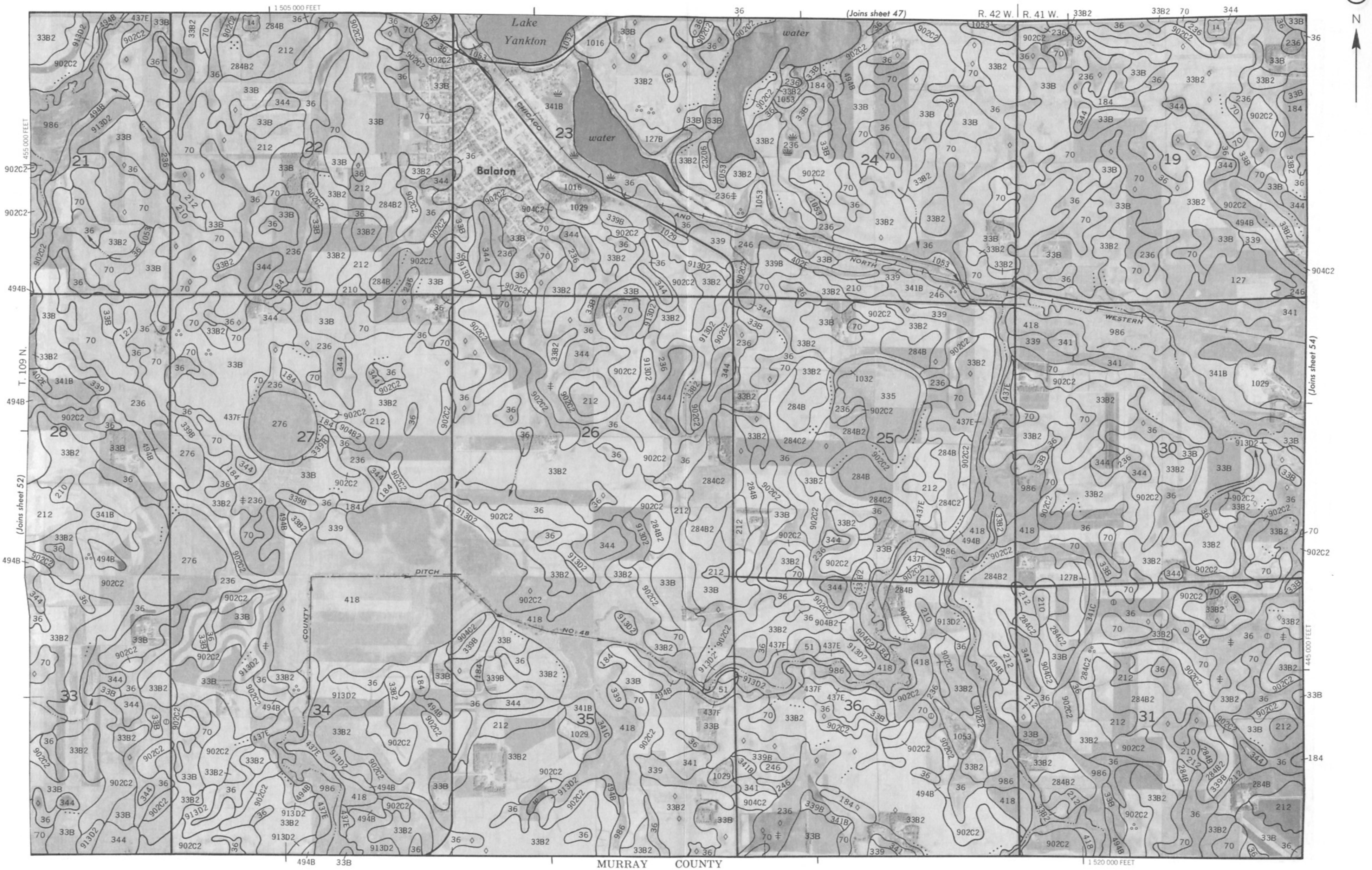
N

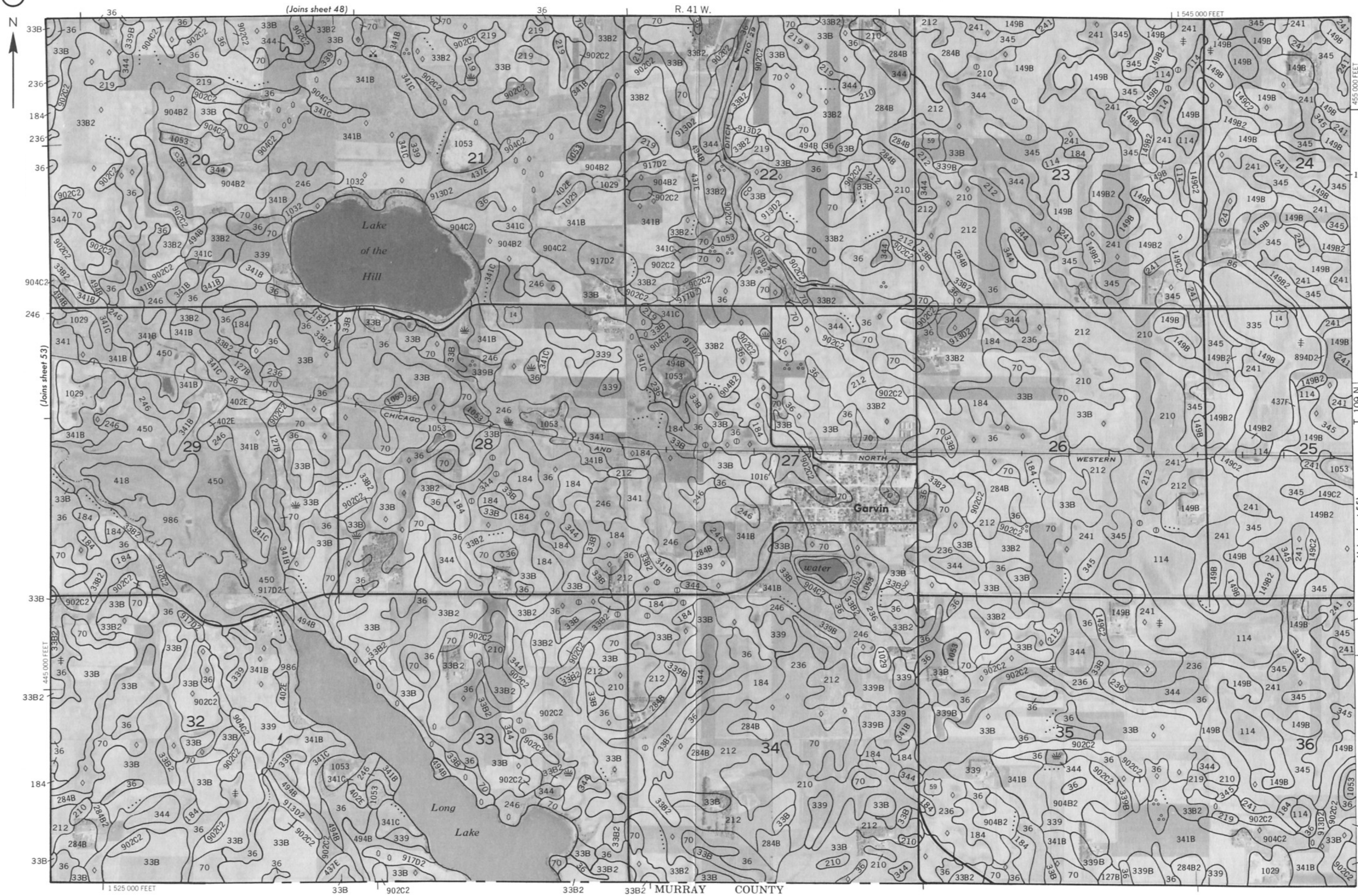

(Joins inset, sheet 39)
R. 40 W.
(Joins sheet 49)
(Joins inset, sheet 55)
REDWOOD COUNTY
SEWAGE LAGOON
SEWAGE LAGOON
TRACY MUNICIPAL AIRPORT
water
TRACY
2
1
11
12
14
13

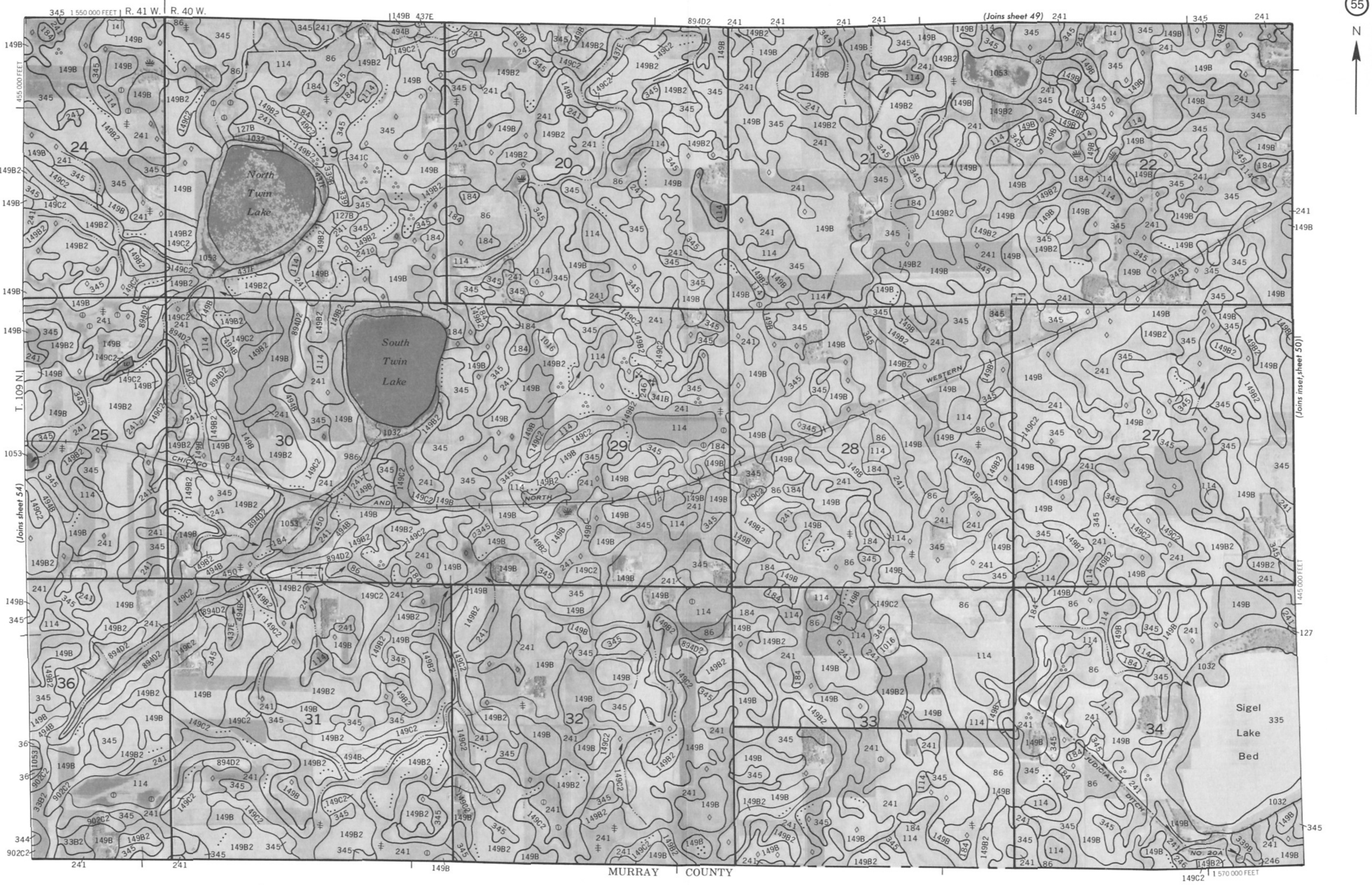

(Joins sheet 50)
R. 40 W.
1 580 000 FEET
TRACY
CHICAGO AND NORTH WESTERN
445 000 FEET
(Joins sheet 55)
T. 109 N.
REDWOOD COUNTY
Sigel Lake Bed
1 575 000 FEET
MURRAY COUNTY
23
24
26
25
35
36


1 455 000 FEET
R. 43 W.
(Joins sheet 45)
N
Florence
JUDICIAL DITCH
NO. 13
NORTHERN
BURLINGTON
19
20
21
22
27
28
29
30
31
32
33
34
East Twin Lake
West Twin Lake
Mitchell Lake
Sanderson Lake
Section 33 Lake
Redwood River
T. 109 N.
455 000 FEET
LINCOLN COUNTY
(Joins sheet 52)
445 000 FEET
PIPESTONE COUNTY
MURRAY COUNTY
1 475 000 FEET


N
(Joins sheet 46)
R. 43 W.
R. 42 W.
1 500 000 FEET
455 000 FEET
T. 109 N.
(Joins sheet 51)
(Joins sheet 53)
445 000 FEET
1 480 000 FEET
MURRAY COUNTY
Redwood River
Cottonwood River
water
23
24
19
20
21
26
25
30
29
28
35
36
31
32
33


N
1 505 000 FEET
(Joins sheet 47)
R. 42 W.
R. 41 W.
Lake Yankton
water
Balaton
CHICAGO AND NORTH WESTERN
455 000 FEET
T. 109 N.
(Joins sheet 52)
(Joins sheet 54)
445 000 FEET
DITCH
COUNTY
NO. 48
1 520 000 FEET
MURRAY COUNTY
19
21
22
23
24
25
26
27
28
30
31
33
34
35
36


N
(Joins sheet 48)
R. 41 W.
1 545 000 FEET
455 000 FEET
(Joins sheet 53)
(Joins sheet 55)
T. 109 N.
445 000 FEET
1 525 000 FEET
Lake of the Hill
Long Lake
Garvin
water
DITCH NO. 29
CHICAGO AND NORTH WESTERN
MURRAY COUNTY


55
N
R. 41 W.
R. 40 W.
T. 109 N.
1 550 000 FEET
455 000 FEET
445 000 FEET
1 570 000 FEET
(Joins sheet 49)
(Joins sheet 54)
(Joins inset, sheet 50)
North Twin Lake
South Twin Lake
Sigel Lake Bed
CHICAGO
AND
NORTH
WESTERN
JUDICIAL
DITCH
NO. 20A
MURRAY COUNTY